The Bank Lending Channel of Monetary Policy Transmission: Thailand's experience

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Declaration

Except where otherwise indicated this thesis is my own work

P. Ruphanitkit.

Paisan Ruphanitkit
January 1988

To my parents

Acknowledgments

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I have never regretted a single day I have spent here in Australia. For me, Australia is a truly wonderful country. I return home full of fond memories of this country and her people. However, studying far away from home unforgivably deprived me of the

chance to care for my ailing father who passed away before I completed my study. His eternal love has provided me with energy and determination to finish my PhD.

Abstract

The mechanism by which monetary policy is transmitted to the real economy has always been at the centre of macroeconomic debate. This thesis analyzes two important channels of monetary policy transmission: the conventional money channel and the bank lending channel. The conventional money channel, traditionally inferred in the standard IS-LM model, has long been a dominant work horse in macroeconomics.

However, in recent years, there has been a resurgence of interest in what is known as the bank lending channel of monetary policy transmission. The foundation of the lending view rests on the notion of asymmetric information leading to imperfections in the capital market. The lending view contends that owing to imperfect information there are a large number of potential borrowers who do not have access to open market funds, and hence have to rely on banks for financing their investment and spending. As a result, anything which disrupts normal banking activity is likely to affect these bank-dependent borrowers and have macroeconomic implications.

To see how the lending view can be distinguished from the conventional money channel and how it operates, a simple theoretical model is developed and then tested using Thailand's data. Thailand is a country where the commercial banks are the most dominant institutions in the financial market. As a result, monetary policy which affects the commercial banks' normal activity should have a major impact on the real economy.

This thesis attempts to analyze the lending view both theoretically and empirically. In the theoretical analysis, it is argued that if monetary policy is conducted through conventional open market operations, the lending channel is likely to be an enhancement mechanism of the conventional money channel, not a truly independent channel.

Nonetheless, if the central bank is prepared to cause a "credit crunch" by bringing down the supply of bank loans more directly, then the lending channel can possibly operate independently of the conventional money channel. Except in the special case of direct credit actions, the lending channel's effectiveness depends crucially on how banks respond to monetary tightening. If banks were able to offset a decline in bank reserves after a tightening of monetary policy either by selling off excess government bonds or issuing their own "bonds" (e.g. certificates of deposits), then the lending channel would be ineffective.

In the empirical analysis, it is found that in the short run it is possible for bank loans to initially rise, instead of falling, after monetary tightening. This "perverse" short term behaviour of bank loans can be attributable, among other things, to the existence of bank liability management and the quasi-contractual nature of bank loans. It is also found that in comparison with narrow monetary aggregates (M1), bank credit appears to explain more of the changes in the output measure than M1, lending some support for the lending view's call for the recognition of bank loans in monetary policy transmission.

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Glossary

Organizations

BOT = The Bank of Thailand

BIBF = Bangkok International Banking Facility

EEF = Exchange Equalization Fund

IMF = International Monetary Fund

GATT = General Agreement on Tariff and Trade

MOF = The Ministry of Finance

SET = The Stock Exchange of Thailand

Monetary and Financial Variables

CP = Commercial paper

CDs = Certificates of Deposit

ECDs = Euro Convertible Debentures

FRAs = Forward Rate Agreements

MB = Monetary Base

M1= Narrow Monetary Aggregate (MB plus Currency)

M2 = Broad Monetary Aggregate (M1 plus time and saving deposits)

NCDs = Negotiable Certificates of Deposit

Variables in the Theoretical Model

B^C = the central bank's bond holding

B^B = banks' bond holding

B^H = households' bond holding

BD = banks' deposits with the central bank

b = a cost of borrowing in the central banks' reserve market minus bond yield

C = currency

C^C = the central banks' currency holding

C^B = banks' currency holding

C^F = firms' currency holding

C^H = households' currency holding

CE = total value of consumption expenditures

c = real C

DD = demand deposits

e = exchange rate

e_C = the interest rate elasticity of demand for certificates of deposit

e_L = the interest rate elasticity of demand for loans

f = forward premium or discount

F = forward exchange rate

G = government expenditures

g = real G

GNP = gross national product

GDP = gross domestic product

H = high power money (=MB)

h = the ratio of public demand for holding money

I = total value of investment expenditures

i = real I

IR = international reserves

K^B = banks' capital

K^F = firms' capital

L = total bank loans

L^F = bank loans to firms

L^H = bank loans to households

L^D = loan demand

L^S = loan supply

NX = net export

m = real M1

m* = the central bank's direct credit action

M^D = money demand

M^S = money supply

Rf = total private transfer payments to foreigners

r = bond interest rate

r^L = loan interest rate

r = interest rate on certificates of deposit

RB = borrowed reserves

RE = excess reserves

RF = net free reserves

RR = required reserves

RU = unborrowed reserves

P = aggregate price level

S = gross private saving

s = real S

T = net tax revenue

t = real T

TR = total reserves

v = a proportion of bank reserves held in bonds

W^F = the corporate sector's net wealth

W^H = the household sector's net wealth

W^B = the banking sector's net wealth

W^C = the central bank's net wealth

Y = national income

y = real Y

z = a statutory reserve requirement ratio

z^D = a statutory reserve requirement ratio on demand deposits

z^C = a statutory reserve requirement ratio on certificates of deposit

ψ = a fixed cost of providing demand deposits

μ = money multiplier

Abbreviations in the Empirical Model

ARMA = autoregressive moving average

ADF = Augmented Dickey Fuller test of serial correlation

DF = Dickey Fuller test of serial correlation

OLS = ordinary least square

VAR = vetor autoregression

UVAR = unrestricted VAR

SVAR = structural VAR

Chapter One

Introduction

1.1. Overview

In macroeconomic analysis, it is commonly agreed that monetary policy does have real effects, at least in the short run. However, there are different views on how monetary policy is transmitted to the real economy. In the conventional view of monetary policy transmission, monetary policy operates through the liability (money) side of bank balance sheets. Monetary tightening reduces reserves from the banking system. A fall in reserves results in a decline in transactions deposits, driving up the nominal interest rate. A rise in the interest rate in turn affects the real economy. In this conventional money view, reduced availability of bank loans does not matter as firms can supposedly maintain their investment and spending by borrowing elsewhere.

The lending view, on the other hand, contends that bank loans do matter and monetary policy can also be transmitted through the asset (credit) side of bank balance sheets. The lending view's key point of departure from the conventional money view is its rejection of the notion that all non-monetary assets are perfect substitutes. In the lending view, for some borrowers, non-bank sources of credit are not perfect substitutes for bank credit. Thus, a tight monetary policy shrinking the supply of bank loans is likely to affect these bank-dependent borrowers' spending and investment and hence aggregate demand.

The lending view proposes a three-asset model as an alternative to the conventional two-asset IS-LM model. This three-asset model explicitly incorporates bank loans into the analysis of monetary policy transmission. In the IS-LM model, there are two assets: money and bonds. In the lending-view model, there are three assets: money, bonds, and bank loans. The lending view argues that due to imperfect information in the capital market bonds and loans are imperfect substitutes and should be taken into account separately when analyzing monetary policy propagation.

1.2. Thesis Purpose

This thesis is borne out of frustration. Most studies on the lending view tend to either verbally discuss the theoretical logic behind the lending view or focus on empirical testing. For example, Bernanke and Blinder (1988) study appears to be the first and perhaps the only theoretical study attempting to set up a formal theoretical model of the lending channel. However, their study is rather too short to give a complete picture of the lending view. Studies which follow seem to pay even less attention to the theoretical setting. Kashyap and Stein (1993) study, despite being the only one which appears to provide the most comprehensive theoretical analysis and review of the lending view, is still nothing more than a verbal account of the lending view.

To analyze the lending view both theoretically and empirically, this study will attempt not only to develop a theoretical model but also to undertake empirical testing using Thailand's data. Most studies on the lending view have been drawn entirely from

developed countries, largely the United States. This study will attempt to apply the theory of the lending view to Thailand, an emerging developing country.

In the theoretical model, we will analyze the operation of the lending channel, the distinction between the conventional money channel and the lending channel, and the necessary conditions required for the existence of the lending channel. In the empirical model, we will examine the operation and the importance of the lending channel to monetary policy management in Thailand and how the importance of the lending channel has been affected by recent financial deregulation and development. A number of studies have been done on various aspects of monetary policy in Thailand, but none of these studies has ever analyzed Thailand's monetary policy from the perspective of the lending-view theory. Our study is probably in the vanguard of this direction of research on Thailand.

1.3. Methodology used in this thesis

As mentioned above, this study attempts to analyze the lending view both theoretically and empirically.

1.3.a. Theoretical analysis

To see how the lending channel operates and how it can be distinguished from the conventional money channel, a simple theoretical model is developed. As suggested by Kashyap and Stein (1993), the easiest way to define exactly what the lending view means is to contrast the lending view with the simpler and better-known money view. Following Bernanke and Blinder (1988), the conventional IS-LM model is modified to incorporate the bank-loan market. In the conventional IS-LM model, on the demand

side of the economy there are only two markets: the goods market and the money market; the bond market is conveniently suppressed by Walras' Law.

The equilibrium condition in the goods market is represented by the IS curve, while that in the money market is represented by the LM curve. The introduction of the third market (the loan market) entails the modification of the IS curve to incorporate the loan market. The incorporation of the goods market and the loan market results in the creation of the CC (credit and commodity) curve and the CC-LM model. By exploiting the principle of bank profit maximization, the theoretical model is then further expanded to analyze the conditions required for the existence and effectiveness of the lending channel.

1.3.b. Empirical analysis

To examine the operation and importance of the lending channel, two key empirical tests are undertaken on the transmission of monetary policy through the lending channel and on the forecasting power of credit shocks relative to money shocks. The econometric technique used in the study is a vector autoregression (VAR). The VAR model introduced by Sims (1980) provides a flexible and tractable framework for analyzing a dynamic inter-relationship or inter-dependence among economic time series variables.

In this study, two empirical results are extracted from the VAR model: the impulse response function and the variance decomposition. The impulse response function is useful for analyzing the dynamic response of endogenous variables to exogenous

shocks. The variance decomposition is useful for analyzing the relative importance of exogenous shocks to movements in endogenous variables.

1.4. Thesis Structure

The rest of this thesis is organized as follows. Chapter Two provides an overview of Thailand's financial market, recent financial development and monetary policy procedure. It explains the structure of the Thai financial market, the scope of recent financial liberalization, and the mechanism of monetary policy implementation in Thailand. Chapter Three briefly reviews the literature of monetary policy transmission channels. It will spell out what is meant by the conventional money channel and the lending channel.

Chapter Four develops a theoretical model of the lending view. This theoretical model is developed to address three key questions: first, how can the lending channel be distinguished from the conventional money channel?; second, is the lending channel an independent channel or merely an enhancement mechanism to the money channel?; and third, what are the necessary conditions for the existence of the lending channel. Chapter Five describes econometric techniques used in the empirical analysis and outlines the model specification. Chapter six undertakes the empirical investigations and presents the results. Chapter Seven concludes and gives some final remarks.

Chapter Two

Monetary Policy and Thailand's Financial Market

2.1. Introduction

To understand the mechanism of monetary policy transmission, one needs to understand a country's financial and monetary structure. As pointed out by Kashyap and Stein (1993), the importance of the lending channel is likely to be sensitive to a number of institutional characteristics of the financial market. The aim of this chapter is to provide an overview of Thailand's financial and monetary structure and recent financial development. The main focus is on the financial market, monetary policy procedure, and recent financial liberalization. This chapter is organized into five sections. Section 2.2 describes Thailand's money and capital markets. Section 2.3 summarizes the scope of financial liberalization from the late 1980s. Section 2.4 explains Thailand's monetary policy procedure. Section 2.5 concludes.

2.2. Thailand's Financial Market

The Thai financial market can be categorized into two distinct markets: money and capital markets. The money market is a market where temporary surpluses are channelled into temporary loans of funds usually with maturity of one year or less. Commercial banks and finance companies are traditionally major institutions in this market. The capital market is, on the other hand, a market for long-term lending and borrowing, normally longer than one year. The stock market and debt instrument (bond) market are typically the most important institutions in the capital market.

2.2.a. Money market

In the money market, there is a wide variety of financial institutions. Most of them are privately owned, but some are wholly or partially owned by the government. Commercial banks are by far the most important among the different types of financial institutions and form the largest group in terms of total assets, deposits and credit extension. Since the money market is largely dominated by the commercial banks and, to a much lesser extent, by finance companies, only the commercial banks and finance companies are to be discussed here.

2.2.a.i. Commercial banks

As discussed at length in the following chapters, in the lending view, banks play a special and unique role in providing credit to a number of potential borrowers who find it difficult and expensive to borrow directly in open markets. The banks' prominent role is highlighted by the existence of asymmetric or imperfect information between borrowers and lenders. With their expertise in gathering information about borrowers, evaluating investment plans, and monitoring borrowers after receipt of loans, banks have a competitive edge over security and debt instrument markets for financing certain types of borrowers.

In Thailand, the first commercial bank was a foreign bank branch, the Hong Kong and Shanghai Bank, set up in 1888. The first Thai commercial bank was established in 1906. Prior to the boom in the stock market in 1986, the commercial banks were by far the most dominant players not only in the money market but also in the capital market.

Table 2.1: Thailand's Commercial Banks (as of January 1997, in millions of baht)

Banks	Major Shareholders	Year of Opening	Assets		Loans		Deposits	
			B$	%	B$	%	B$	%
Large Banks								
Bangkok B	Sophonpanich family	1944	1,149	22.43	903	21.9	791	21.8
Thai Farmers B	Lamsam family	1945	661	12.9	525	12.7	520	14.3
Krung Thai B*	Ministry of Finance	1966	713	13.92	586	14.2	533	14.7
Siam Commercial B	Crown Property Bureau	1906	545	10.64	443	10.7	393	10.8
sub-total			*3,068*	*59.9*	*2,457*	*59.5*	*2,237*	*61.6*
Medium Banks								
B of Ayudhya	Ratanarak family	1945	426	8.3	351	8.5	343	9.5
Thai Military B	Thai Armed Forces	1957	332	6.5	270	6.6	195	5.4
First Bangkok City B	Siriwatanapakdi family	1934	251	4.9	217	5.3	159	4.4
Siam City B	Mahadamrongkul and Srifungueng families	1941	237	4.6	181	4.4	169	4.7
Bangkok Metro B	Tejapaibul family	1950	198	3.9	158	3.8	146	4
Bangkok B of Com**	Jalichadra family	1944	186	3.6	154	3.7	111	3.1
sub-total			*1,630*	*31.8*	*1,331*	*32.3*	*1,123*	*31.1*
Small Banks								
B of Asia	Euarchukiati and Phatraprasit families	1939	128	2.5	105	2.6	71	2
Thai Danu B	Tuchida and Thavisin Families	1949	121	2.4	99	2.4	76	2.1
Union B of Bangkok	Cholvijarn and Asvinvichitr families	1949	67	1.3	49	1.2	46	1.3
Nakornthon B	Wanglee family	1933	68	1.31	51	1.3	45	1.2
Laem Thong B	Chansrichawla family	1948	42	0.8	31	0.8	29	0.8
sub-total			*426*	*8.31*	*335*	*8.3*	*267*	*7.4*
Total			5,124	100	4,123	100	3,627	100

Source: Asia Week (August 3, 1994) and the Asian Wallstreet Journal (22 June 95), Bangkok Post (7 March 1997) and Bank of Thailand Monthly Bulletin

*Established as a result of a merger between the Bank of Agriculture (found in 1950) and the Provincial Bank (found in 1943) (Chiyasoot, 1993)

**Due to its massive-scale mismanagement, Bangkok Bank of Commerce was taken over by the Bank of Thailand on 17 May 1996, and is currently under a "rehabilitation" program.

At the end of 1996, there were 15 commercial banks. In Table 2.1, among the existing 15 commercial banks, the Krung Thai Bank is the only government-owned bank. The Thai Military Bank is partially owned by the military, which controls around 30% of the bank's shares. The four largest banks control around 60 % of the total commercial bank assets and market share. As shown in Table 2.1, major shareholders of most commercial banks are big families of Chinese origin. This is not a surprise given that most of these banks were set up by the trading houses of these families.

Banking reform

After the second oil shock in the late 1970s, the Thai government was preoccupied with the promotion of export-oriented policy with no serious attempt to reform the financial system. Prior to the late 1980s, Thailand's domestic financial market was highly protected. Foreign banks were allowed to have just one branch in Bangkok, and faced many restrictions preventing them from competing with the domestic banks. The number of domestic banks was also limited. As shown in Table 2.1, currently there are just 15 banks.

The result of the long negligence on financial reform was a financial crisis in 1983. Several financial companies collapsed and a handful of major commercial banks were on the brink of bankruptcy. The monetary authorities were prompted to embark upon serious reform in the financial sector with the aim of restoring credibility to the financial institutions and making them more efficient in mobilizing badly-needed funds for the country's rapidly growing investment[1].

The first stage of banking reform was the introduction of a new legislation prohibiting an individual from holding more than 5% of bank shares outstanding. This legislation was aimed specifically at diversifying bank ownership. However, the legislation seems to have failed to diversify bank ownership: loopholes in the legislation have allowed the initial owners of the existing banks to get around it[2].

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[1]As discussed later, financial reform without proper financial supervision can lead to financial crisis as Thailand is currently experiencing.

[2]On the heels of the flotation of the baht in July 1997, many small and medium sized banks faced a run on their deposits and mounting bad debts due to a sharp slowdown of the economy and the collapse of the property sector. These banks were forced to increase their capital or face insolvency. Because the country is in the middle of a financial crisis, these banks have had to woo foreign investors to buy their

It was not until the late 1980s that wide-ranging banking reform was undertaken as part of a comprehensive financial liberalization plan. (Section 2.3 will describe the scope of financial liberalization in detail.) This financial reform was aimed at increasing competition and efficiency in the banking sector. With the advent of financial liberalization, the commercial banks are now facing unprecedented challenges from two fronts.

The first is on savings mobilization. The emergence of the stock market and the fixed-income debt instruments market has drained savings away from bank deposits. There are now a number of mutual funds available to Thai savers who otherwise would have deposited their money in the banks. From 1992 to the first quarter of 1994, equity and fixed-income mutual funds expanded more than 20 fold to over B$ 200 billion.

The second is on credit extension. Financial deregulation has come with mixed blessings for the commercial banks. On one hand, they enjoy greater freedom in running their businesses. On the other hand, they have to face stiffer competition from not only among themselves but also from non-intermediary institutions, for example, the stock market and the debt instrument market. A booming stock market and a burgeoning bond market have provided potential borrowers with a wider option to raise

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new shares. On September 14, 1997, the government introduced various measures to rescue the ailing financial sector. One of the measures was a relaxation of the ownership rule allowing foreigners to hold more than 50 % of equity in the financial institutions for up to 10 years (Previously foreigners were not allowed to own more than 25%). After the ten-year period their stake will be diluted by a capital increase. However, there is a grandfather clause which will allow foreign investors to extend their majority ownership beyond the 10-year period, if the capital increase does not reduce foreign ownership below 50%. In any case, foreign shareholding of up to 49% would be granted indefinitely, making Thailand's financial system one of the most open in Asia.

funds. Large and medium sized firms are now able to raise funds more directly from the public through the stock and the debt instruments markets.

2.2.a.ii. Finance companies

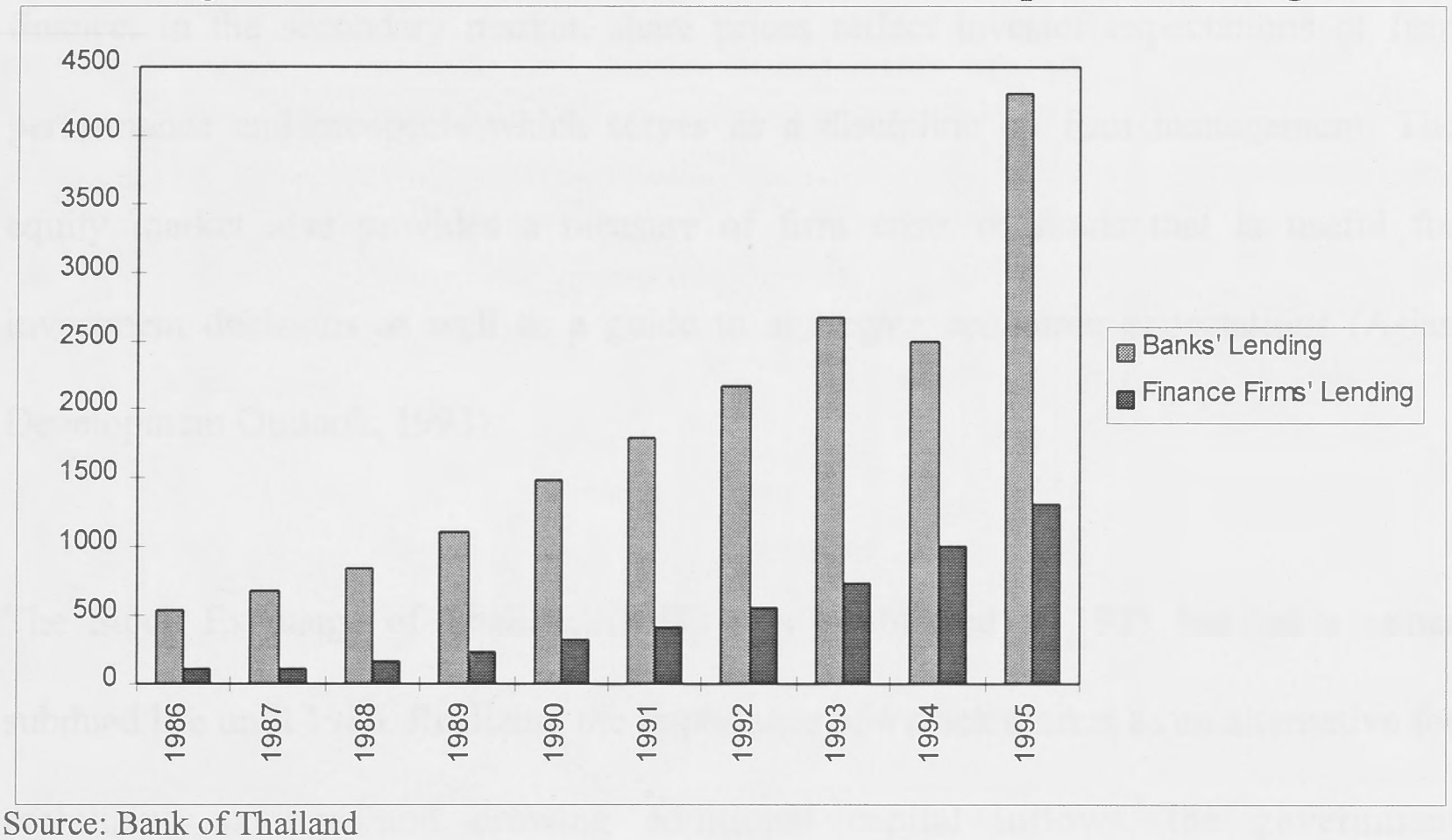
The first fully-fledged finance companies in Thailand began operating in 1969. As of January 1997, there were 91 licensed finance companies, their activities ranging from short-term finance, hire purchase, underwriting, and investment advisory services. Unlike commercial banks, finance companies are not permitted to take deposits from the public, but they can raise funds through the issuance of promissory notes or other similar instruments.

Even though the operations of finance companies are in many ways similar to those of the commercial banks and the interest rates on promissory notes are generally significantly higher than those of bank deposits, finance companies are by no means serious rivals to the commercial banks, particularly in the area of lending and mobilizing funds. Figure 2.1 shows that lending by the commercial banks is far larger than that by finance companies.

The commercial banks' relatively better and more solid reputation has appeared to be attractive enough to draw most of the funds from the public. Another reason which could also explain why there has been no serious competition between the finance companies and the commercial banks is that many finance companies are, in fact, affiliates of the commercial banks (especially the big ones). Before interest rate ceilings were lifted, the commercial banks which have financial affiliates channelled some of their funds to their affiliates: financial firm lending rates are generally higher than the

commercial bank rates. Thus, the only conflict, if any, may be a conflict of interest due to the cross-ownership[3].

Figure 2.1: Commercial Banks and Finance Companies' Lending



Source: Bank of Thailand

As mentioned above, the commercial banks are facing increasing competition not only among themselves but also from non-bank institutions, especially the stock market and the debt instrument market. The following section will explain the phenomenal growth of the capital market driven by the rapid expansion of the stock market and the debt instrument market .

2.2b. Capital market

At present, the Thai capital market comprises three major markets: the stock market, the debt instrument market, and more recently the offshore banking market.

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[3] Due to a financial crisis caused by a slump in the property sector and the financial institutions' over-exposure to the property sector, 58 of a total 91 financial firms were suspended and ordered by the Central Bank to come up with viable merger or recapitalization plans (16 were suspended on June 27, 1997 and another 42 on August 5, 1997). Only two of the 58 suspended finance firms were able to come

2.2.b.i. The Stock Exchange of Thailand (SET)

Equity markets have a number of benefits to both equity borrowers (firms) and equity investors (households). The primary market provides firms with access to low risk finance. In the secondary market, share prices reflect investor expectations of firm performance and prospects which serves as a discipline on firm management. The equity market also provides a measure of firm costs of funds that is useful for investment decisions as well as a guide to aggregate economic expectations (Asian Development Outlook, 1993).

The Stock Exchange of Thailand (SET) was established in 1975 but led a rather subdued life until 1986. Realizing the importance of a stock market as an alternative for mobilizing savings and drawing additional capital inflows, the government promulgated the "Securities Exchange of Thailand Act (1986)" to expedite the development of the equity market. This 1986 Act was aimed at encouraging private companies to list in the market by offering them tax incentives. The government also introduced a package of generous tax privileges for domestic and foreign investors. These tax incentives together with the attractiveness of the booming economy have led to a surge in foreign portfolio investment.

Domestic investors have also played a major role in expanding the stock market. They now have a choice of investing in the market either directly or indirectly via mutual funds. Investing via mutual funds has been encouraged by the monetary authorities as an efficient way to mobilize long-term savings and to enhance the stability of the equity

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up with viable recapitalization plans and allowed to reopen on December 8, 1997. The remaining 56

market. In 1994, there were around 70 mutual funds, mostly closed-end equity funds, with assets worth more than 200 billion baht. These mutual funds accounted for about 7.7% of the SET capitalization in 1994.

Table 2.2: Total Market Capitalization(billions of baht) at SET, 1987-94

Year	Total Market Capitalization	%GDP	Bank Credit
1987	138.16	11.3	691.78
1988	223.87	16	866.86
1989	658.94	39.5	1,126
1990	613.51	29.5	1,494.00
1991	897.16	37.7	1,807.56
1992	1,485	55.5	2,182.36
1993	3,325.40	112.1	2,662.90
1994	3,300.80	93.3	3,341.90

Source: Bank of Thailand Annual Report

In Table 2.2, Thailand's equity market grew at an exceptional pace in terms of capitalization. The total market capitalization increased from 138 billion baht (11.3% of GDP) in 1987 to 3,325 billion baht (112.1% of GDP) in 1993, surpassing loans outstanding of the commercial banks. The SET index increased from 879 in 1989 to 1,380 in 1993. The stock market's phenomenal growth can be attributable to an increase in the number of listed corporations (from 175 in 1989 to 389 in 1994), a growing number of new share issues, a strong growth in share prices and dividends, and a relaxation of exchange policy helping to facilitate foreign portfolio investment. Given its relatively low ratio of capitalization to GDP, about 106.2 at the peak in 1993 compared to 328% in Malaysia, 350% in Hong Kong, and 242% in Singapore, the SET has the potential to grow even larger in the long term.

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firms are expected to be shut down.

Though the equity market is currently the most important institution in the capital market, its dominance is facing a challenge from the newly-emerged debt instruments market. According to the World Bank (1995), Thailand's debt instrument market's potential growth is by no means less than the stock market's.

2.2.b.ii. Debt instrument market

In the early stages of economic development, financial markets are typically very limited. Intermediaries, mainly banks, receive most savings and provide the bulk of finance. As economies develop and become more sophisticated, however, stock and bond markets generally account for a larger share of financing. The range of financial products broadens and the services provided by financial markets respond to the increasingly diverse demands of both investors and borrowers.

The availability of more financial instruments increases the way in which investors can save. Investors no longer restrict themselves to placing funds in bank deposits. Instead, they can place their savings directly in government and private securities. Likewise, as markets develop, borrowers have more means of raising funds. Instead of being restricted to bank loans, borrowers can reduce risk and cost by spreading funds between many types of financial instruments (Asian Development Bank, 1993).

In Thailand, debt instruments have become more popular among Thai corporations in recent years. From the corporations' point of view, debt instruments have provided them with a greater opportunity to finance large-scale and long-term investment which usually cannot easily be satisfied by bank finance or internally generated funds. In

addition, unlike equity financing, debt financing allows firms to retain greater control over corporate decision making. Some debt instruments, such as Eurobond, or convertible and non-convertible debentures can be used to raise funds at a lower cost than bank loans. Another advantage of raising funds through issuing debt instruments over bank borrowing is that firms are not subject to stringent collateral requirements.

Realizing the important role of a debt instruments market in mobilizing domestic savings, the monetary authorities have been vigorously promoting the development of the market by encouraging both state enterprises and corporations to raise funds through the issuance of debt instruments. The monetary authorities' main objective in fostering the bond market is twofold: first, to enhance the efficiency of saving mobilization to reduce the country's chronic current account deficit which is entirely derived from the gap between domestic private savings and investment[4]; second, to promote fixed long-term savings which are more important to the country's infrastructure development than prevalent short-term and usually floating-rate bank deposits.

Prior to 1992, some debentures and other long-term debt instruments were issued by the private sector, but were not popular due to complex laws and lack of investor understanding. In addition, the Civil and Commercial Code only allowed public companies listed in the stock market to issue debentures. As a result, the number of primary issues by the private sector was quite limited. However, after the enactment of

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[4]Current account balance = (Saving-Investment) + (Tax Revenue - Government Expenditure). Since 1988, the government's fiscal balance has been in surplus, so the current account deficit is solely a result of the gap between saving and (private) investment. This gap has largely been filled by short-term capital

the Securities and Exchange Act in May 1992, private limited companies were also allowed to issue debentures.

Qualified companies have since mobilized funds through debentures. The volume of domestic debentures quadrupled from $B 2.9 billion in 1992 to $B 30.3 billion in 1994. Unlike the market for government bonds where financial intermediaries are major investors, in the private bond market, investors are individuals and corporations who have excess liquidity and consider corporate debenture investment as an alternative to bank deposits.

Types of Debt Instruments in Thailand

Debt instruments in Thailand can be categorized into three distinctive groups.

Long-term instruments

From 1933 to 1990, the government was the main issuer of long-term bonds. Owing to the government successive budget surpluses since 1988, no new government bonds have been issued since 1990. However, the government has encouraged the state enterprises to finance infrastructure investment through bond issues. State enterprises now become major issuers of long-term bonds. Table 2.3 shows that the share of government bonds in the bond market declined from 95% in 1988 to just 18% in 1994, while that of state enterprise bonds increased from 5% to 56% during the same period.

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inflows, mostly short term funds, leaving the domestic economy very vulnerable to capital outflows. Thailand's financial crisis in 1997 is a classic example of the danger posed by short-term "hot" money.

Table 2.3: Composition of the Domestic Bond Market (billions of baht)

	1988	1989	1990	1991	1992	1993	1994
Government	213	201.4	195.2	150.8	133.9	100.7	66.2
	[95]	[94]	[91]	[75]	[62]	[38]	[18]
State Enterprise	10.5	12	18.2	50.2	76.2	134.9	190.4
	[5]	[6]	[9]	[25]	[35]	[52]	[56]
Corporate	0	0	0	0	5.1	26.3	88
	[0]	[0]	[0]	[0]	[3]	[10]	[26]
Total	223.5	213.4	213	201	215.2	261.9	334.6
	[100]	[100]	[100]	[100]	[100]	[100]	[100]

Source: The Bank of Thailand(BOT), The Securities and Exchange Commission (SEC), The World Bank (WB). Percentages are shown in parenthesis

Table 2.4: Primary Market Issuance of Private Fixed-Income Securities(billion Baht)

	1991	1992	1993	1994	1995
1. Domestic Issues					
1.1. Debentures	6.3	8.84	20.35	58.89	50.55
1.2. Bill of Exchange*	0	0	0	0	38.72
1.3. Negotiable Certificate	0.05	1.56	17.95	17.31	21.39
of Deposit (outstanding)**					
1.4. Floating Rate Note	6.4	5.8	5.73	4.73	3.73
(outstanding)					
1.5. Commercial Paper	271.28	311	390.4	525.43	574.45
(outstanding)					
2. Overseas Issues					
2.1. Debenture	0	0	31.23	50.45	34.98
2.2. Floating Rate Note	n.a	9.29	26.6	49.61	66.29
and Floating Rate					
Certificate of Deposit					
2.3. Negotiable Certificate	n.a	n.a	65.7	65.71	78.261
of Deposits(outstanding)					
2.4. Asian Currency Note	0	0	1	1.3	2.13

*only those issued by finance companies and finance and securities companies

**only those issued by commercial banks

Source: The Bank of Thailand

Medium-term instruments

Corporate convertible bonds with and without warrant, debentures, and medium-term certificates of deposit can be considered medium-term instruments. Following the enactment of the Securities and Exchange Act in May 1992, both public and limited companies (both are listed in the stock market) were allowed to issue corporate debentures and bonds. Table 2.3 indicates that corporate bonds increased from B 5.1 billion (or 3% of the market share) in 1992 to B 88 billion (or 26% of the market share) in 1994.

Short-term instruments

Negotiable certificates of deposits (NCDs), promissory notes, banker's acceptances, bills of exchange, and floating rate notes are typical short-term instruments. NCDs are issued by the commercial banks. Promissory notes are issued by the finance companies. Bill of exchange and banker's acceptances are issued by firms with high credit rating.

In the past, treasury bills issued by the Ministry of Finance (MOF) constituted a major portion of short-term instruments. Since 1989, the MOF has stopped issuing treasury bills. Since then the market for short-term instruments has been steadily dominated by private short-term instruments. In recent years, the market for commercial bills in Thailand has grown rapidly and gained popularity among institutional investors who consider commercial bills as an alternative to bank deposits.

Unlike commercial paper, certificates of deposit are still not widely accepted by domestic investors due to pending tax issues and cumbersome regulations concerning

the issuance of the certificates. Under the current regulations, banks and finance companies are allowed to issue certificates of deposit with a minimum denomination of 500,000 baht, while an amount above 500,000 baht has to be in multiples of 100,000 baht with the maturity of no less than 3 months or more than 3 years. As shown in Table 2.4 , the volume of NCDs is far less than that of commercial paper.

One major obstacle to the development of the bond market in Thailand is the scarcity of government bonds normally used as a benchmark yield for the corporate bond market. Government bonds are generally deemed the best grade bonds in most situations and in most countries. The price of bonds issued by other organizations, such as corporations, is measured against that of government bonds, setting a price for the entire financial system to follow. In response to a steady decline in the supply of government bonds, in 1997 the government amended the Fiscal Budget Act to allow the Ministry of Finance to issue bonds, even when the government was running fiscal surpluses (between 1988-1996 the government budget was in surplus).

Apart from being a source of financing, the bond market can also provide different kinds of market-based monetary policy instruments to substitute for direct instruments, e.g, credit and interest rate ceilings, which tend to be ineffective in a liberalized financial system, The basic idea underlying indirect monetary policy is that given the demand for the central bank liabilities in the form of bank notes and reserve deposits held by banks for clearing purposes or meeting reserve requirements, the central bank can influence short-term interest rates in the interbank market by varying the supply of reserves, over which it has almost total control.

The central bank can manipulate the supply of reserves by buying and selling bonds and other money market instruments. This will, in turn, indirectly affect the availability of credit and interest rates. This kind of indirect mechanism can, however, only work if there is a well-functioning market for bonds and short-term commercial papers. Section 2.4 will discuss in detail the implications of the bond market in monetary policy procedures.

In Thailand, unlike in many other countries, domestic borrowers are allowed to have access to domestic off-shore banking facilities. As part of the government policy to open the domestic market to external competition and to develop Thailand as a regional financial centre, Bangkok International Banking Facility (BIBF) was introduced in 1992 as Thailand's own offshore banking facility.

2.2.b.iii. Bangkok International Banking Facility (BIBF)

An international banking facility or offshore financial centre can be distinguished from its domestic counterpart by three important characteristics.

First, it normally deals with external currencies, not the currency of the country where the facility is located. In this way, financial transactions in the facility are not directly linked with the domestic banking system.

Second, the offshore centre is generally granted a special tax incentive, and exchange controls that are imposed upon the domestic financial market are exempted.

Third, the offshore financial centre is primarily, but not exclusively, for non-resident clients. The scope of interface between residents and their offshore centre must be closely controlled by the host government, which has to balance its conflicting

objectives of promoting its offshore centre and controlling potential abuse by residents (Park and Zwick, 1984: 149).

The Bangkok International Banking Facility (BIBF) was established as Thailand's own offshore banking market with two principal goals: first, to allow more foreign competition in the domestic financial market. As a signatory to the concluded Uruguay Round of GATT, Thailand is committed to increasing foreign access to its domestic market. Therefore, the BIBF was set up to provide greater access for foreign banks in the Thai financial market. The second goal was to develop Bangkok as a regional financial centre. In the initial stage, the government wanted to promote Bangkok as a funding centre for Indochina. As the financial system becomes more sophisticated, the funding centre could be upgraded to a fully-fledged international financial centre like those in Hong Kong and Singapore.

the BIBF was officially unveiled in September 1992 when the Bank of Thailand announced its policy to establish the BIBF and then invited Thai and foreign banks to join the facility. The main business of the BIBF is to mobilize funds from overseas sources to finance domestic and foreign investments in foreign currencies. Banks joining the BIBF are also allowed to raise funds by issuing bonds denominated in major currencies and to engage in loan syndication by acquiring foreign currency loans extended to overseas borrowers. Two special conditions were imposed on the BIBF operations. First, the BIBF activities must be clearly separated from other activities. This includes the separation of assets, documents and accounts. Second, the BIBF

activities for lending in foreign countries must be separated from those for local lending.

Since its inception, most of the lending through the BIBF has gone to domestic borrowers rather than clients in Indochina. A much bigger and more vibrant domestic market makes lending to domestic borrowers relatively more attractive. In 1995, loans via BIBF accounted for around 65.5% of the country's external debt and 57.5% of estimated short-term foreign debt. A rapid increase in domestic lending by the BIBF prompted the Bank of Thailand to impose a ceiling on the BIBF domestic lending, and to raise the minimum amount for each loan from US$ 2 to 5 million in order to keep the BIBF domestic lending under control.

Massive external funds channelled through the BIBF were blamed for causing a bubble growth in the property sector which burst in 1997 and plunged the Thai economy into a deep financial crisis. Thailand's policy of maintaining a stable exchange rate together with a relatively higher domestic interest rate are major incentives for domestic borrowers to seek funds from abroad directly and indirectly via the BIBF. Thailand's *de facto* fixed exchange rate was abolished in favour of a managed floated system on July 2, 1997 (see Appendix II for the detailed evolution of Thailand's exchange rate system).

In Thailand, opening the domestic financial market to foreign competition was driven by not only the country's obligation to the GATT agreement on trade in services but also the government's policy to expedite the development of the financial system and

the integration of the domestic financial market with the international markets. The financial integration has a number of advantages for every country involved. Foreign competition forces domestic institutions to be more efficient and competitive, and helps broaden the range of financial services. It can also accelerate the transfer of financial technology, especially important for developing countries. Countries that succeed in integrating their markets with the rest of the world will gain greater access to capital and many vital financial services[5].

To maximize the benefits of foreign presence in a domestic financial market requires the liberalization of domestic financial institutions and the establishment of a competitive environment. Artificially low interest rates, direct credit controls, barriers to entry and other impediments to competition make it likely that foreign intermediaries will simply come in and capture economic rents from financial distortion, rather than promoting competition and efficiency. the next section will summarize the range of recent financial deregulations in Thailand.

2.3. Recent Financial Liberalization in Thailand

Prior to the late 1980s, financial reform was implemented primarily in response to specific problems, rather than as part of an overall reform strategy. Early financial reforms included, among other things, the introduction of laws empowering the Ministry of Finance to vary the ceiling on the interest rates offered by financial

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[5] However, as discussed later in section 2.4, opening domestic financial markets to outside competition can also pose many potential problems. For instance, if the opening is carried out prematurely and without proper financial supervision, it can lead to volatile capital flows that can threaten domestic financial stability.

institutions; the establishment of the repurchase market in 1979; and the amendment of the Commercial Banking Act to broaden the ownership of the commercial banks.

In the wake of the financial crisis in 1983 triggered by huge losses in finance companies and their affiliates, the monetary authorities were prompted to strengthen the supervisory and regulatory framework for financial institutions. In 1984, some reforms of the capital market were instituted to stimulate trading in the stock market. By the end of the 1980s, as Thailand's economic development accelerated, it became increasingly evident that comprehensive financial liberalization was urgently needed if the momentum of economic growth was to be maintained.

2.3.a. Rationale for financial liberalization

The rationale for a comprehensive financial liberalization was threefold: first, to enhance the capability and efficiency of the financial sector in mobilizing domestic savings to meet a rapidly growing investment demand; second, to comply with the GATT agreement on trade in services; and third, to promote Thailand as a regional financial centre.

2.3.b. The scope of financial liberalization

The process of financial liberalization in Thailand has been a gradual one. As mentioned above, the early deregulation was concentrated on restructuring domestic interest rates and diversifying bank ownership. In 1989, the monetary authorities took the first step towards comprehensive financial liberalization by partially lifting interest rate ceilings; since then a series of financial deregulations has followed.

2.3.b.i. Abolition of interest rate ceilings

Like many other developing countries, Thailand had used interest rate ceilings on loans and deposits as a means to prevent excessive competition and to ensure stability of the financial system as well as to provide low cost funds to encourage investment in a "priority" sector. However, artificially low interest rates produce a bias towards current consumption reducing savings below the socially optimum level. In a situation where inflation is high, real interest rate on bank deposits falls. Savers tend to reduce their bank deposits, and attempt to hedge against inflation by holding non-depreciating assets. As a consequence, financial deepening is discouraged, and more resources are turned away from productive activities. The abolition of interest rate ceilings is, thus, a crucial step towards a liberalized financial system.

In Thailand, the first important step towards interest rate liberalization was the floating of interest rates on time deposits with maturity of more than one year in June 1989. This interest rate floating was taken with two main objectives: first, to create a more flexible interest rate regime; second, to encourage long-term savings. After the first floating, interest rate ceilings were gradually removed. In March 1990, the ceilings on all time deposits were lifted. In January 1992, the ceilings on saving deposits were abolished; five months later the last ceilings, the ceilings on loans, were removed. All interest rates were allowed to move in tandem with market forces[6].

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[6] On September 26, 1997, the Bank of Thailand reintroduced interest rate ceilings on deposits to allay the financial institutions' intense competition for deposits which could threaten the country's financial stability. Continuous capital outflows and a run on bank deposits in the wake of the financial crisis leading to a flotation of the baht and a suspension of 58 financial companies have forced the commercial banks and finance companies to fiercely compete for domestic funds.

Interest rate liberalization has major implications for the behaviour of financial aggregates. Lifting interest rate ceilings gives banks greater control over the interest rates they pay on deposits and opens the way for a change from asset to liability management. Under the ceiling system in which there were controls on interest rates banks could pay on deposits, on interest rates they could charge on loans, and on the maturity of deposits they could raise; banks behave largely as asset managers. They have to accept passively whatever deposits come their way, since controls over interest rates limit their scope to go out into the market and compete for deposits. In a deregulated system, banks tend to move towards managing their liability (deposit) flows to meet loan demand.

2.3.b.ii. Relaxation of foreign exchange controls

In Thailand, foreign exchange controls were employed to stabilize exchange fluctuation between the baht and other foreign currencies and to ensure that sufficient foreign exchange reserves were maintained at all times. The Bank of Thailand administered the exchange control by delegating responsibility for the approval of most transactions to authorized banks. The banks were only allowed to purchase foreign currencies in the form of notes and travel cheques and to sell a limited amount of foreign note and coins.

These exchange controls have become increasingly ineffective as the economy becomes more integrated into the world economy. The opening up of foreign trade has led to greater opportunities for evasion of capital controls via, for instance, under and over-invoicing of trade transactions. Eventually, it becomes inevitable for the government to contemplate the relaxation of exchange controls.

The most important exchange liberalization occurred on 22 May 1990 when the government announced its acceptance of Article VIII of the International Monetary Fund (IMF) agreement. The acceptance means that Thailand no longer places restrictions on payments and transfers for international current account transactions, and refrain from imposing multiple exchange rates in order to give fair financial treatment to all trading partners. Commercial banks were allowed to engage freely in foreign exchange transactions related to import and export of goods and services.

After the acceptance of Article VIII, further exchange deregulation was carried out. The first round of deregulation allowed selling and buying foreign currencies by the commercial banks to the public for current transactions without prior approval from the Bank of Thailand. Nonetheless, there are some exceptions where approvals are still required, for example, the purchase of foreign exchange for buying foreign real estate and securities. In April 1991, the second round of deregulation was undertaken, which included, inter alia, free repatriation of direct and portfolio investment funds, dividends, and offshore loans repayment, and permission to non-residents to open "non- resident" baht accounts with any authorized banks in Thailand[7].

2.3.b.iii. Improving efficiency of portfolio management

In a financially repressed country, government intervention in banking activities and portfolio management is common. For example, a high reserve requirement is usually used as a means by which the government can impose an implicit tax on the financial

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[7]In an attempt to curb unscrupulous currency speculation, the Bank of Thailand announced "temporary" capital controls in May 1997, which, in effect, resulted in a two-tier exchange rate system: onshore and offshore exchange rates for the baht. Restrictions were imposed on some foreign exchange transactions and the amount of the baht to be taken out of the country.

system. In a country where an open market for primary securities does not exist, the government cannot sell treasury bonds or bills directly to the public. The government, thus, has to extract implicit tax revenue from the financial system by setting a non-interest-bearing reserve requirement.

If inflation is high and unpredictable, the reserve requirement of commercial banks becomes a basis on which the inflation tax is levied. A high reserve requirement forces commercial banks to reduce deposit rates and raise lending rates, thereby, contracting the flow of loanable funds. The inflation on reserves is, thus, shared between depositors, whose interest earnings are driven down, and borrowers, whose cost of borrowing is driven up (McKinnon, 1991: 48).

Between 1966-87, the Thai government continuously ran a budget deficit at an average of around 2.5% of GDP. To finance the deficit, the government had to issue bonds and treasury bills. Since the real rates of return on the government securities were relatively lower than those on bank deposits, there was not enough public demand for the securities. As a result, the government had to sell them to the commercial banks by requiring them to hold government securities as part of their legal reserves. The government also required the banks to hold its securities in the amount of no less than 16% of outstanding deposits as a condition for opening new branches. These requirements created a significant constraint for the banks in managing their assets and liabilities.

Since 1988, due to a commitment to a disciplinary fiscal policy and a windfall from the booming economy, the government has managed to run successive budget surpluses at an average of 2-3 % of GDP. As a result, the government has had no need to borrow from the public. The last series of treasury bills was issued in 1989 and government bonds in 1990. With no new government securities, banks found it difficult to meet the reserve requirement and the condition required for opening new branches. To relieve the security shortage and also to promote greater flexibility and efficiency in banking operations, the banks were allowed to open new branches without holding government securities. The commercial banks were also permitted to use non-government securities, for example, the Bank of Thailand's bonds, debentures and other debt instruments issued by state enterprises as part of their legal reserves.

2.3.b.iv. Expansion of financial institutions' activities

In general, financial institutions' contribution to the economy depends on the quantity and quality of their services and the efficiency with which these services are provided. As the real economy becomes more developed and sophisticated, there is a need for new financial services. In addition, an increase in competition leads to a narrow loan-deposit interest rate spread, forcing the commercial banks to look for other sources of income to compensate for a decline in interest income. Understanding this situation, the Bank of Thailand allowed the commercial banks to undertake the following activities:

-In 1987, banks were allowed to undertake the preparation of feasibility studies for investment projects; loan syndication; the provision of consulting services on acquisitions, mergers or consolidation, recommendation of insurance companies to

insure collateral assets, and the provision of custodian services. In 1988, finance companies were also permitted to engage in these activities.

-In 1992, commercial banks as well as financial companies were permitted to act as financial advisers and underwriters for government securities and debt instruments for state enterprises and provide information services for their clients.

The commercial banks themselves have introduced a variety of financial instruments to meet a more sophisticated demand for commercial bank services. Most of these services and instruments come from banks' own initiative. Since the mid 1980s, a number of financial innovations have been introduced into the market. These can be broadly classified into two groups:

Introduction of modern technology in the banking operations

The introduction of Automatic Teller Machines (ATMs) and credit cards in the mid 1980s, was one of the most important milestone in the banking sector and has led to major changes in payment transferring, and the structure of bank deposits. These changes have been reflected by a continuous shift from demand deposits to saving deposits; the demand deposits to total deposits ratio declined steadily from about 22 per cent in 1971 to 4 per cent in 1990 while the saving deposits to total deposits ratio increased from around 9 per cent to 28 per cent during the same period.

Changes in the composition of bank deposits have created a problem of how to define money, particularly the targeted monetary aggregates. With the growing popularity of the automatic fund transfer system, the boundary between monetary assets (e.g, current

account) and non-monetary assets(e.g, transaction account) became ambiguous. The narrowly-defined monetary aggregate, M1, appeared to decrease while the broadly-defined M2 tended to increase. Choosing between the two monetary aggregates as targeted aggregates is not easy: M1 is more easily controlled, but its links to the real sector have become tenuous as the interest elasticity of demand for money has risen as a result of financial liberalization and innovation[8]. On the other hand, M2 is generally less susceptible to the monetary authorities' control, but more closely related to the real sector (Glick 1988).

Introduction of new domestic money market instruments and international financial instruments

Since the mid 1980s, a number of new types of domestic financial instruments, such as, floating rate notes, transferable/negotiable certificates of deposit, warrants, Asian Eurobonds, Euro-baht bonds, and (Euro) convertible/ non-convertible debentures, have been introduced (see Appendix I for definitions of these financial instruments). There are also a variety of hedging instruments mostly initiated by branches of foreign banks, and then adopted by domestic banks. These hedging instruments include currency and interest rate swaps, option, and forward rate agreements (FRAs).

These instruments are very important in the world with growing global financial integration and deregulation which requires more sophisticated financial products to manage financial risks. These financial risks increase as more and more countries begin

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8 Since the mid 1980s, many new financial products which are close substitutes to money have been introduced. These include a number of non-M1 assets which can readily substitute for the transaction assets in M1. M1 now contains saving-type assets subject to portfolio redistribution.

to liberalize their financial systems. As interest rates and exchange rates which used to be tightly controlled have become more flexible, the business costs of finance have become volatile. Consequently, firms want to be protected from the volatility. This creates a demand for a new variety of financial instruments.

2.4. Monetary Policy Procedure in Thailand

Monetary policy is a major tool for achieving medium-term goals of price stability and output growth and short-term stabilization in response to economic disturbances. In Thailand, the main monetary policy goal is to achieve sustainable economic growth with a reasonable level of financial system stability. In recent years, price stability seems to have been the most important in monetary policy goal (Kittisrikanwan, Supapongse, Jantarangs, 1995).

Mechanisms through which the monetary policy is operated depend on the financial and monetary structure of the country. In Thailand, monetary policy has traditionally been conducted via three major mechanisms: the discount window facility; the repurchase market; and the Exchange Equalization Fund (EEF). Through these mechanisms, the Bank of Thailand exerts its influence over the supply of money and credit; domestic interest rates; and in some cases the value of the currency.

2.4.a. Monetary policy mechanisms

2.4.a.i. Discount window facility

The commercial banks can borrow through the discount window by placing government, state enterprise, and central bank bonds as collateral. By operating through

this facility the central bank acts as a lender of last resort. The central bank can influence the availability and cost of reserve money by varying a discount rate (a bank rate) as well as setting a discount lending ceiling.

In Thailand, there are two types of discount operations: discount and rediscount operations.

Discount operations

Discount operations provide banks with borrowed reserves at a discount rate usually set somewhat below short-term market rates. Discount lending is extended against the pledge of government, qualified state enterprise and central bank securities at 90% of face value for a maximum duration of 7 days. Prior to November 1994, only the commercial banks were allowed access to this facility. After financial deregulation, the demarcation line between finance companies and commercial banks became blurred, so finance companies were also allowed access to the facility. Each individual institution is given a quota based on the size of its deposits or the volume of public borrowing in the case of finance companies which are not allowed to take deposits. When banks and finance companies borrow from a discount window, they deposit the amount of the borrowed reserves at the Bank of Thailand in their names.

Discount window operations provide the commercial banks and finance companies with the opportunity to acquire reserves cheaply and quickly within the context of overall credit conditions set by the Bank of Thailand. Discount operations thus contribute to the significant degree of the Central Bank's control over the money supply. For instance, if the commercial banks' access to a discount facility is tightened, banks must

take greater precaution when extending loans. Adjustment of the discount rate (or the bank rate), which is usually not very frequent, normally carries a strong policy signal to the financial market about the future direction of interest rates that the central bank would like to pursue.

Rediscount Operations

Rediscount operations involve a two-tier process in which the commercial banks purchase and discount papers from their customers, and this reduces their reserves. As a consequence, the banks will have to rediscount these papers with the Bank of Thailand. Under this operation, the Bank of Thailand can change the rediscount rate, which in turn affects the willingness to engage in rediscounting and hence the reserve position of the commercial banks. Traditionally, the Bank of Thailand employs rediscount facilities as a means of allocating financial resources at preferential interest rates to priority sectors, mostly the export sector, through the banks.

Each bank is allocated a quota within which it can sell eligible promissory notes to the Bank of Thailand at concessional rates. During the 1970s and 1980s, the amount of refinancing grew rapidly as the interest rates charged were fixed. In 1988, alarmed by mounting monetary pressure, The Bank of Thailand restructured the refinancing scheme to restrain an excessive use of this facility. After the establishment of the Export-Import Bank in February 1994, the operation of the export credit refinancing scheme was transferred to the Export-Import Bank.

2.4.a.ii. Repurchase market

In many countries, open market operations are employed relatively more often than other instruments. With open market operations, the central bank can reduce or increase the monetary base. However, in order to conduct effective open-market operations, the volume of government securities in the secondary markets must be large enough for the central bank to trade in them in order to regulate the flow of domestic credits from the commercial banking system.

In Thailand, owing to the scarcity of government bonds as well as the relatively underdeveloped secondary market, open market operations are only confined to trading in approved securities between the Bank of Thailand and the commercial banks and among the commercial banks themselves. The market for this trading is called a "repurchase market", which was established in 1979, and since then has become the Bank of Thailand's most important channel for liquidity management.

Generally, the repurchase market is a place where the central bank provides non-borrowed reserves to commercial banks. In the repurchase market, market participants purchase and sell bonds with an agreement to repurchase and resell. In Thailand, the Bank of Thailand acts as an arranger for trading between the commercial banks. Since all transactions go through the Bank, it can influence the movements of repurchase agreement transactions through changes in interest rates as well as through discretionary intervention in the market.

However, as a monetary policy tool, the repurchase market still has two notable shortcomings: first, acting as an arranger does not allow the Bank of Thailand to take the initiative in its open market operations; it can only exercise its influence in the market when there is an imbalance of bids and offers outstanding in the market. Self-initiated operations are not applicable within the existing arrangement. Second, market participants mostly prefer short-term transactions; over 90% of the transaction volume is concentrated on the transaction of maturity of less than 14 days. This limits the Bank of Thailand's ability to influence the liquidity in the financial market over a longer time horizon (Kittisrikanwan, Supapongse, Jantarangs 1995).

As shown in Table 2.5, the share of the commercial banks' borrowing from the Bank of Thailand steadily decreased from 49% of total borrowing in 1988 to just over 1% in 1995, while that from banks abroad markedly increased from about 45% to over 90% during the same period. In Table 2.6, the share of borrowing in the banks' total funds doubled from about 11% in 1988 to 24% in 1995, whereas that of deposits declined from around 83% to 67% during the same period. Financial deregulation while maintaining a policy of stable exchange rate is the major contributing factor to the commercial banks' increasing dependence on foreign borrowing.

Alarmed by the commercial banks' heavy reliance on short-term foreign borrowing, in 1996 the Bank of Thailand was prompted to respond by specifically imposing a cash reserve requirement ratio of 7% on a short-term borrowing of less than one year and raising the limit on the net open foreign liability position of the commercial banks.

Table 2.5: Sources of Borrowing by Thai Commercial Banks (billion of baht)

From	1988	1989	1990	1991	1992	1993	1994	1995
Bank of Thailand	57.57	41.22	42.34	37.61	37.67	21.22	13.69	14.68
	(48.91)	(32.81)	(27.46)	(24.38)	(21.61)	(5.95)	(1.72)	(1.25)
Other financial	7.3	14.9	15.39	10.37	16.38	20	55.86	86.31
institutions in	(6.2)	(11.86)	(9.98)	(6.72)	(9.40)	(5.62)	(6.98)	(7.35)
Thailand								
Banks abroad	52.83	69.52	96.43	106.3	120.24	314.22	721.83	1064.15
	(44.89)	(55.33)	(62.56)	(68.90)	(68.99)	(88.14)	(90.24)	(90.66)
Other						1.05	8.48	8.52
						(.29)	(1.06)	(0.74)
Total Borrowing	117.7	125.64	154.16	154.28	174.29	356.49	799.86	1173.66

Source: Bank of Thailand Monthly Bulletin

Table 2.6: Sources of Funds Supplying Thai Commercial Banks(billion of baht)

Sources of funds	1988	1989	1990	1991	1992	1993	1994	1995
Capital fund	68.33	83.11	111.31	143.46	170.23	222.44	306.45	394.95
	(6.33)	(6.18)	(6.52)	(7.00)	(7.15)	(7.40)	(7.92)	(8.20)
Borrowing	117.7	125.64	154.16	154.28	174.29	356.49	799.86	1,173.66
	(10.90)	(9.35)	(9.03)	(7.52)	(7.32)	(11.86)	(20.68)	(24.36)
Deposits	893.41	1,135.07	1,440.81	1,751.47	2,035.08	2,427.29	2,760.94	3,249.98
	(82.77)	(84.47)	(84.45)	(85.48)	(85.53)	(80.74)	(71.39)	(67.44)
Total funds	1,079.44	1,343.82	1,706.28	2,049.21	2,379.60	3,006.22	3,867.25	4,818.59

Source: Bank of Thailand Monthly Bulletin

To boost its declining influence in managing market liquidity and interest rates in the post deregulation era, the Bank of Thailand in 1996 embarked on developing a new system of open market operations which would be similar to those used in developed economies. Under the new system, the Bank of Thailand appoints direct bond dealers to

act as representatives for the Bank in the bond market. Through these dealers, the Bank of Thailand can manage money market liquidity without having to wait for financial institutions' call to buy and sell as in the repurchase market.

By instructing the representative dealers to quote the biding and offering bond rate it deems appropriate, the Bank of Thailand stands ready to intervene in the market at that rate. The Bank of Thailand also set up the Financial Institutions Development Fund which has become a liquidity pipeline in the inter-bank and inter-finance markets. The Fund will borrow from the financial institutions when there is excess liquidity, and lend when there is tight liquidity.

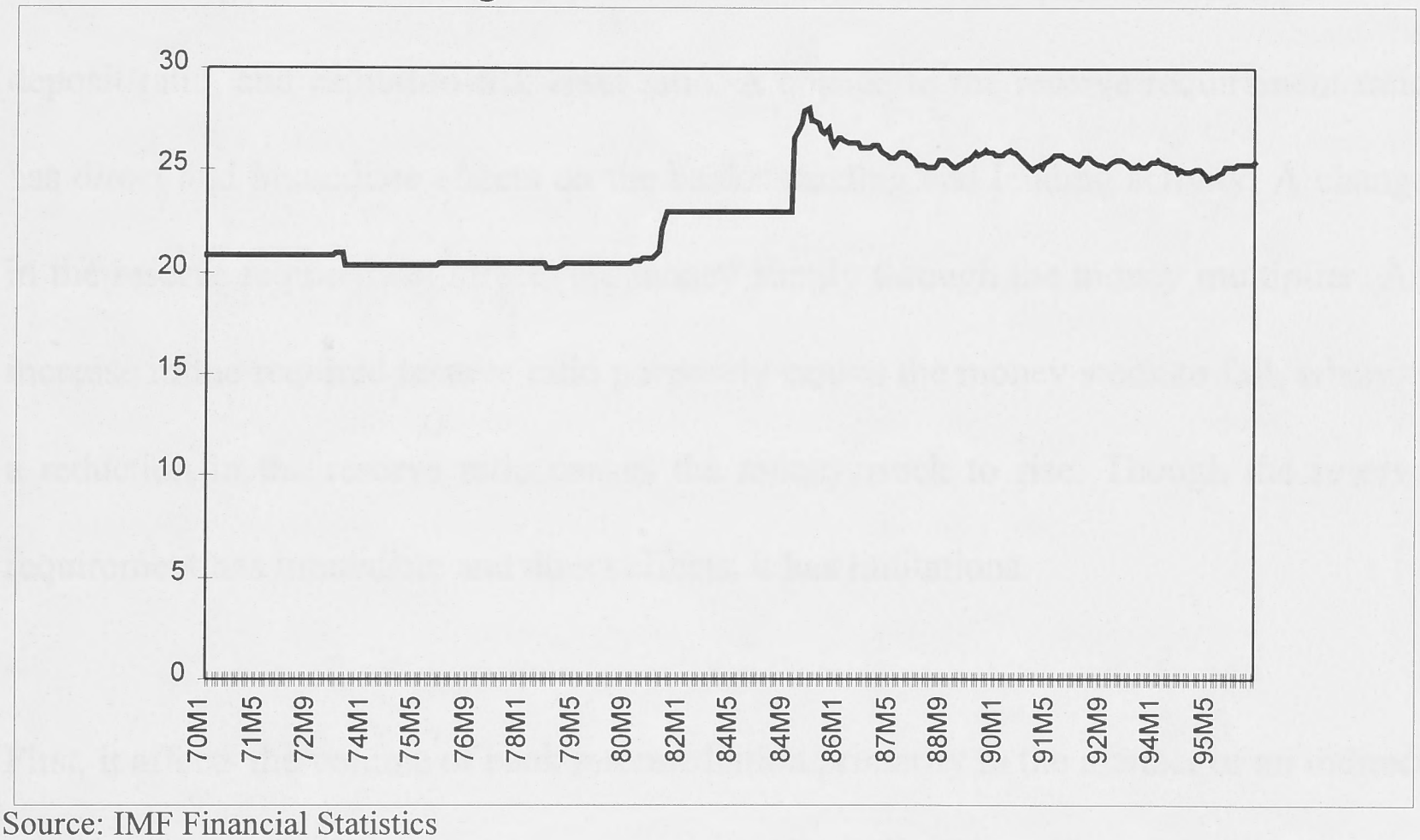
2.4.a.iii. Exchange Equalization Fund (EEF)

The EEF is an authority under the jurisdiction of the Bank of Thailand. Its main responsibility is to handle the stabilization of the exchange rate. During 1963 to 1972 and 1981 to 1984, the EEF was solely responsible for maintaining the fixed exchange rate between the baht and the U.S dollar. After the adoption of a basket-pegged exchange rate system in late 1984, the EEF served as a mechanism through which the basket-pegged system was implemented (see Appendix II for the chronological evolution of Thailand's exchange rate system).

Under the basket-pegged regime, the EEF daily announces the mid-rate for US$/baht and stands ready to buy and sell US$ in an unlimited amount at the announced mid-rate plus or minus 0.02 baht. This effectively sets the fluctuation band for the exchange rate. As shown in Figure 2.2, in spite of a move to a more flexible exchange rate system in

1984, the baht has been kept relatively stable. In July 1997, after facing unprecedented speculative attacks on the baht, the Bank of Thailand was forced to adopt a managed floated system. Under this system, the Bank through the EEF will occasionally intervene in the currency market whenever it deems necessary.

Figure 2.2: Thai Baht/US Dollar



Source: IMF Financial Statistics

Before the baht was floated in 1997, the EEF also had served as a channel for the commercial banks to adjust not only their foreign exchange position but also their (baht) liquidity. The commercial banks tended to sell dollars to the EEF when liquidity was tight and interest rates were high and buy dollars when liquidity was high and interest rates were low. In effect, the EEF acted as a "safety valve" for banks to manage their liquidity, especially during periods of abrupt capital inflows or outflows (Kittisrikanwan, Supapongse, Jantarangs 1995).

Apart from the above mechanisms, the Bank of Thailand also conducts its monetary policy through prudential regulations, credit planning, and moral suasion.

2.4.b. Prudential regulations, credit planning, and moral suasion.

2.4.b.i. Prudential regulations

Prudential regulations are normally in the form of a reserve requirement ratio, loan-to-deposit ratio, and capital-to-risk asset ratio. A change in the reserve requirement ratio has direct and immediate effects on the banks' funding and lending activity. A change in the reserve requirement affects the money supply through the money multiplier. An increase in the required reserve ratio purposely causes the money stock to fall, whereas a reduction in the reserve ratio causes the money stock to rise. Though the reserve requirement has immediate and direct effects, it has limitations.

First, it affects the volume of bank intermediation primarily in the manner of an indirect tax. Second, it does not take into account the liquidity inequality of each individual bank. The reserve ratio is imposed on every bank no matter what their liquidity position. Banks with plentiful liquid assets will be able to adjust more easily than banks with a rigid liquidity position. Third, it is very inflexible, only a small change in the ratio will have a profound impact on the bank's provision of intermediary services credit.

In Thailand, the reserve requirement has rarely been altered. The current reserve requirement has been maintained at 7% of total deposits since 1979, previously it was set at 6%. At present, the commercial banks are required to hold 2% of the 7% reserve

requirement ratio in non-interest bearing deposits at the Bank of Thailand, the rest has to be kept as cash in a vault and bonds issued by the government, approved state enterprises and the Bank of Thailand. The reserve maintenance period is currently set at an average of two weeks (previously one week) to allow banks more time to adjust their reserve and thus help to avoid drastic fluctuations in the money market.

Apart from the reserve requirement ratio, the Bank of Thailand has also occasionally imposed the loan-to-deposit ratio in order to restraint banks' credit extension whenever it believes the banks is over-lending and inflationary pressure is mounting. The loan-to-deposit ratio is often introduced in conjunction with a regulation on the commercial banks' foreign exchange exposure used to discourage the banks' reliance on foreign borrowing. As shown in Table 2.5, since the early 1990s, the commercial banks have become heavily dependent on foreign borrowing.

The capital-to-risk asset ratio is also another prudential regulation usually used to ensure a stability of the banking sector. In the wake of the financial crisis in 1997, the Bank of Thailand raised the level of the capital adequacy ratio to ensure the solvency of banks and financial firms. At the onset of the financial crisis, many banks, mostly small and medium-sized banks, and financial companies experienced a run on their deposits. They also faced mounting bad debt as the crisis began to worsen. Recapitalization seems to be the only option for avoiding insolvency. Currently, the banks have to maintain a capital-to-risk asset ratio of 8.5%, and finance firms 7.5%.

2.4.b.ii. Credit planing and moral suasion

The Bank of Thailand has always attached a great deal of importance to commercial banks' credit extension, both in terms of overall growth and sectional distribution. In post financial deregulation, the Bank of Thailand has appeared to rely more on moral suasion which primarily centers on dialogue and discussion between the Bank of Thailand and the commercial banks on the growth and distribution of bank loans. Banks are often required to submit their credit plan to the Bank of Thailand. By analyzing the credit plan, the Bank of Thailand can monitor overall lending growth as well as evaluate its macroeconomic impacts.

In the wake of the financial crisis which began in mid 1997, the adequacy and efficacy of the Bank of Thailand's financial supervision have been under a cloud. Even the Bank itself admitted that its supervision system may have been inadequate, and contributed to the crisis (Joint Statement by the Ministry of Finance and the Bank of Thailand, October, 14, 1997). To understand the extent to which the Bank of Thailand's financial supervision may have contributed to the current financial crisis, one has to look at the origin of the crisis. According to *Phatra Thanakit* Research Institute, one of Thailand's best known economic research centers, the crisis is the result of a massive misallocation of resources and improper financing[9].

During the first half of the 1990s, Thailand had a very high rate of investment, probably one of the highest in the world, about 40% of its GDP (see Table 2.7). This high rate of investment was in itself not a problem, as long as investments were in sectors that

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[9] An in-depth analysis of the current financial crisis is beyond the scope of this thesis.

generated a reasonable rate of return. Unfortunately, a large proportion of investments went into non-traded (low productivity) sectors, in particular the property sector, and also some protected industrial sectors, such as, steel, petrochemical, and cement. The non-traded sector received a huge portion of capital inflows as it was then perceived to have a high profit potential and relatively easy business compared to much more competitive exporting sectors. In short, the first problem was a misallocation of resources on a grand scale.

The other problem was that these investments were "improperly financed". Foreign short-term capital was used to finance longer-term investments which generated little or no foreign exchange earnings. This "improper financing" was made possible by financial liberalization which allowed huge capital inflows. Thailand's external debt increased from US$25 billion in 1990 to US$75 billion in 1996: most of the debt was private. Massive capital inflows were encouraged by Thailand's impressive high rate of economic growth over the past decade and the stability of the currency.

Thai financial institutions found it much cheaper to borrow abroad and lend to their domestic clients (see Table 2.5 for a surge in banks' foreign borrowing). Exchange rate risk was secured by the country's *de facto* fixed exchange rate. Low cost foreign capital made many projects, which would otherwise be commercially un-viable, viable. Foreign lenders, mostly the Japaneses, were pleased to lend to Thai borrowers as the economy looked healthy. But they were, nonetheless, still cautious and hence largely lent short-term, rather than long term. Thai financial institutions were led to believe that the country's high economic growth would be sustainable, and were willing to borrow

short term[10]. Thus, the second cause of the crisis was the improper or mismatched financing: short-term funds were used to finance long term projects.

Table 2.7: Thailand's Macroeconomic Figures

	1985	1990	1991	1992	1993	1994	1995	1996
Gross Domestic Investment (percent of GDP)	24	41.3	42.7	40	40.4	41	40	41
Gross Domestic Saving (percent of GDP)	20.6	34.2	35.2	35.2	35	35.2	34.2	35
Current Account (percent of GDP)	-4.1	-8.5	-7.7	-5.7	-5.1	-5.6	-7.1	-8.6
Budget Balance (percent of GDP)	-5.3	5	4.9	3	2.2	1.8	2.7	1.5
International Reserves (US$ billion)	3	14.3	18.4	21.2	25.4	30.3	37	38.7
External Debt Outstanding (US$ billion)	14.7 [10.1]	25.1 [11.5]	33.4 [12.8]	37.4 [13.1]	46.8 [14.2]	55 [15.7]	68.2 [16.4]	75 [16.7]

Numbers in bracket are public external debt
Sources: Bank of Thailand Annual Report and Asian Development Outlook

Thailand's financial woe was exacerbated by a sudden slump in export. In 1996, export growth was registered at a rare zero per cent. The current account deficit soared to 8.6% of GDP in 1996[11]. As a result, speculations on the devaluation of the baht were mounting. In May 1997, the Bank of Thailand spent some US$24 billion of its foreign reserves in a futile attempt to defend the baht. The baht was in the end floated on June 2, 1997. The International Monetary Fund (IMF) had to arrange a US$17.2 billion package to rescue Thailand's battered economy.

A sharp fall of the baht after the float blew up the country's external debt. Most of Thailand's foreign borrowing was un-hedged. Financial institutions have had to face

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[10]In fact, it was not only the financial institutions that borrowed heavily overseas, big non-bank corporates also borrowed abroad.

[11] Warr (1997) points out that a loss of competitiveness in the export-oriented labour-intensive industries was the main cause of Thailand's export slump. In recent years, Thailand's labour intensive export has faced fierce competition from China and Vietnam.

not only a blown-up foreign debt but also rising non-performing loans. High interest rate, economic slump, and a sharp depreciation of the baht have pushed a number of companies, especially in the property sector, to the a brink of bankruptcy; many have already gone bankrupt.

Questions have been asked: Was the Bank of Thailand aware that banks and finance companies had become heavily dependent on (short-term) foreign borrowing and over-exposure to the property sector? and Did the Bank try to do something to curb it? To answer these questions, one has to look at the monetary policy procedure and the exchange rate system. Theoretically, Thailand could not have an independent monetary policy under a fixed exchange rate: any attempt by the Central Bank to alter domestic money supply would be offset by capital flows. Historically, what helped the Bank of Thailand to retain some degree of monetary independence were various forms of capital controls (Warr, 1997).

In the early 1990s, most of the capital controls were removed as part of a financial liberalization program. Because the exchange rate system was kept unchanged, the Bank of Thailand was unable to use conventional monetary policy tools, such as, interest rate policy, to curb massive (short-term) capital inflows, and had to resort to several forms of quantitative measures, such as, the reserve requirement ratio, loan-to-deposit ratio, and credit targeting.

A reserve requirement of 7% on non-resident baht deposits was imposed in August 1995. In June 1996, a 7% cash reserve requirement on short-term lending through the

Bangkok International Banking Facility (BIBF) was introduced. The loan-to-deposit ratio was also adjusted many times during 1995-1996 to encourage the commercial banks to rely more on domestic funds. By mid-1996, the economy still showed signs of overheating. Inflationary pressure was on the rise. A glut in the property sector also became palpable. The Bank of Thailand was prompted to set a target of 21% credit growth for 1996; loans to the property sector were specifically targeted to squeeze[12].

By late 1996, as tight monetary measures began to bear fruit, the country's export suddenly slumped and consequently the current account deficit surged. The economy quickly deteriorated due to a combination of high interest rates and low export growth. By mid-1997, things had gone from bad to worse after the Bank of Thailand gave up the 13-year-old basket-pegged exchange rate system. The baht plunged from about 26 baht per US dollar before the float to, at one time, around 56 baht.

The Bank of Thailand is now subject to strong criticism for its weak financial supervision which allowed banks and financial firms to become heavily dependent on (short-term) foreign borrowing and over-exposure to the property lending. Some critics have argued that had the Bank of Thailand acted quicker to curb banks and financial firms' heavy foreign borrowing and over-lending to the property sector, the financial crisis could have been avoid or, at least, less severe.

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[12] The importance of direct credit actions, e.g, credit controls, will be discussed in Chapters Four and Six. As pointed out by Bernanke and Lown (1991), a credit crunch tends to precede an economic slowdown or even recession.

The Bank of Thailand's exchange rate policy was also a target of criticism. Rumours of an impending devaluation had been in the air for some time before the baht was finally floated. These rumours had major financial effects. The expectation of a devaluation induced outflows of speculative capital, and might, in part, have contributed to the sudden slump in the property market and the stock market in 1996. Had the Bank of Thailand floated the baht in the early 1990s after financial deregulation or, at least, loosened its tight grip on the baht, it could have, to a significant extent, deterred speculative capital inflows and also enhanced the Bank's monetary policy management.

The causes and consequences of the current financial crisis and the lessons to be learned from the crisis will surely be a subject of study for years to come. At the time this thesis is being finalized, the crisis is not yet over and may get even worse. Ironically, the crisis could, in the long term, turn out to be a blessing in disguise. Politically, it has already led to a speedy promulgation of a new constitution which will pave the way for radical political reform. Economically, it will lead to a major restructuring of the financial system. A sharp devaluation of the baht will also lead to a reallocation of resources from the non-traded sector to the exporting sector.

2.5. Conclusion

Thailand's financial market can be divided into two distinct markets: money market and capital market. Prior to the late 1980s, the distinction between the two markets was blurred, as the commercial banks in the absence of active equity and bond markets were by far the most dominant institutions in both money and capital markets. In recent

years, the commercial banks have experienced an increased challenge not only from intermediary financial institutions but also from non-intermediary institutions.

Since the late 1980s, Thailand has embarked on a wide-ranging financial reform to enhance the capacity and efficiency of the financial sector and also to comply with the GATT agreement on trade in services. Financial reform covers four main areas: abolishing interest rate ceilings, relaxing foreign exchange controls, improving efficiency of financial institutions' portfolio management, and expanding financial institutions' activities.

In Thailand, monetary policy has traditionally been conducted via three major mechanisms: the discount window facility; the repurchase market; and the Exchange Equalization Fund (EEF). Through these mechanisms, the Bank of Thailand exerts its influence over the supply of money and credit, domestic interest rates; and in some cases the value of the currency. The Bank of Thailand also conducts its monetary policy through prudential regulations, credit planning, and moral suasion. In the wake of the financial crisis which began in 1997, the adequacy and efficacy of the Bank of Thailand's financial supervision have come under a cloud. The financial supervision may have been inadequate, and contributed to the financial crisis.

Chapter Three

Literature Review on Monetary Policy Transmission Channels

3.1. Introduction

Monetary policy is a tool for achieving short and medium-term stabilization of output and inflation. Despite being a major policy tool, monetary policy has sometimes generated unexpected and unwanted consequences. To achieve desirable results, the central bank must have an accurate assessment of the timing and the impact of its policy on the economy. This requires an understanding of the channel through which monetary policy decisions are transmitted to the real economy (Mishkin, 1995).

The aim of this chapter is to provide a concise survey of the literature on the channels of monetary policy transmission with emphasis on the lending channel of monetary policy transmission. This chapter is organized into five sections. Section 3.2 outlines major approaches to monetary policy analysis. Section 3.3 and 3.4 articulate the concept of the money view and the lending view of monetary policy transmission, and a conceptual distinction between the two views. Section 3.5 concludes

3.2. Approaches to Monetary Policy Analysis

For decades, the issue of how monetary policy action is transmitted to the real economy has been a key topic of debate in macroeconomics. Traditionally, monetary policy transmission has been explained by what is known as the Keynesian interest-rate transmission mechanism, entrenched in the conventional IS-LM model. Though widely

referred to in most macroeconomics textbooks, the IS-LM model is definitely not the only model used to analyze the transmission of monetary policy.

As pointed out by Brunner and Meltzer (1990), there are several alternative approaches to the analysis of the money supply process and monetary policy transmission. Three approaches have been used most extensively in recent work. The first one was illustrated by the work of Benjamin Friedman (1977). Friedman sought to estimate a structural model of the determination of long term interest rates. The primary thrust of Friedman's model was to eschew a familiar unrestricted reduced-form term-structure equation, and to use instead a set of structural equations representing supplies of and demands for long-term bonds.

The second approach involves extending the range of assets and the number of relative prices that affect aggregate demand. A work by Brunner and Meltzer (1990) is one that follows this approach. Departing from standard analyses, such as, the IS-LM model, Brunner and Meltzer showed that in a model where there is more than one asset price and interest rate, one can see interaction between the credit market and the money market. Changes in the stocks of money and debt caused by either government financing or open market operations lead to substitution between money, bonds, and capital, even if a market interest rate is controlled.

The third approach, the one adopted in this thesis, remains within the standard IS-LM paradigm, but involves some modifications, such as, disaggregating asset markets to achieve a more complete analysis of the money market without altering the existing

structure of the model. In the IS-LM model, the entire system of all asset-market equations is reduced into a single money market equilibrium condition, represented by the LM curve, and a single interest rate for analytical purposes. No distinction is, thus, made between inside money (money produced by the central bank) and outside money (money created by intermediaries). The role of bank credit in monetary policy transmission and the interaction between the credit market and the money market are left unrecognized in the conventional IS-LM model.

The inadequacy of the conventional IS-LM model in recognizing and identifying the important role of bank has led to a quest for an alternative model which can provide a more complete analysis of monetary policy. In recent years, there has been a growing interest in what is known as the lending view of monetary policy transmission. In the lending view, it is argued that due to the existence of market imperfection, bank loans and bonds are not perfect substitutes. The imperfect substitution between bank loans and bonds means they should be taken into account separately in the analysis of monetary policy propagation[1].

A theoretical model to be developed in the following chapter is inspired by a model proposed by Bernanke and Blinder (1988). In our model, we slightly modify the conventional IS-LM model without altering the structure of the conventional model. But before we proceed to the theoretical model, it is useful to spell out what exactly the lending view is and how it can be distinguished from the well-know money view.

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[1]Although there appear to be some similarities between the lending-view model and the model proposed by Brunner and Meltzer (1990) which also argues that bonds and capital are not perfect substitutes, the latter model does not seem to clearly indicate the important role of bank loans.

Kashyap and Stein (1994) suggest that the easiest way to understand the operation of the lending channel is to contrast the lending view with the better-known money view. So we begin by briefly revisiting the money view.

3.3. The Conventional View of Monetary Policy Transmission

For over half of a century, since Hicks introduced the IS-LM model to relate money and interest rate to aggregate income or output in 1937, the IS-LM model has become a work-horse model of most macroeconomics textbook and policy discussion (Meltzer, 1995). In the IS-LM model, there are two assets: money and bonds and one interest rate. Monetary policy is transmitted through changes in the interest rate. A reduction in the money supply is conducive to a rise in the interest rate[2].

A rise in the interest rate or the cost of borrowing reduces producer investment spending on inventories and capital goods, and also consumer spending on durable goods, thereby leading to a decline in aggregate demand and a fall in output, provided that there is some form of imperfect price adjustment[3]. This transmission channel is generally known as the conventional money view of monetary policy transmission (or the basic Keynesian textbook model).

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[2]Open market sale of government bonds leaves households to hold more bonds and less money in their portfolios. If prices do not instaneously adjust to changes in the money supply, the fall in households' money holdings represents a decline in real money balances. To restore equilibrium, the real interest rate on bonds must rise, raising the cost of capital for a range of planned investment activities and interest-sensitive spending (Hubbard,1994).

[3]Price adjustment is crucial to a distinction between real and nominal interest rates and is guided by two important assumptions: rational expectations and rigidities of wages and goods prices. An increase in the nominal interest rate will bring about an increase in the real interest rate if the rationally expected inflation rate does not increase by the same amount. However, over the long run, once knowledge of the size of monetary impulses become available, money wages and commodity prices will rise, and the effect on the real interest rate will fade away. Prices and money increase in the same proportion, and the real long-term interest rate returns to the path determined by fundamental economic factors (Taylor, 1995) .

The conventional money view is, however, criticized for its incomplete explanation of the transmission process. In particular, it does not explain exactly how monetary policy affects the real economy. The money view only predicts that changes in monetary policy are eventually followed by changes in output. What happens in the interim is left un-answered. This is why some call what occurs in between the monetary policy procedure and the final outcome a "black box" mechanism.

The money view only assumes that changes in the interest rate caused by changes in the money supply will influence the cost of capital and spending on durable goods. It does not say how the interest rate that is considered relevant to money demand (the short-term rate) affects the rate deemed relevant to investment (the long-term rate).

Even though it is conceivable that there is a link between the short-term and the long-term interest rates, empirical studies of the so-called interest rate sensitive components of aggregate spending have had great difficulty in identifying quantitatively significant "interest-rate" effects (Bernanke and Gertler,1995)[4]. Disenchantment with the conventional money view over its incomplete explanation of the transmission mechanism and the lack of support for a strong "interest-rate" effect has led to a search for other alternative explanations for monetary policy transmission channels[5]. The bank

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[4]The link between the short-term and the long-term interest rates can be explained by the expectation model of the term structure. According to this model, the long-term rate is influenced by the expected weighted average of the future short-term rate. For instance, if the central bank takes actions to raise the short-term interest rate and market participants expect the short-term rate to decline gradually back to staring value in the future, then the long-term rate will rise less than the short-term rate. On the other hand, if the central bank takes actions to raise the short-term rate and market participants expect that this increase is just the first stage of longer sequence of increases, then the long-term rate will rise by more than the short-term rate.

[5]According to Duguay (1994), the lack of support for a strong interest rate effect may be in part attributable to the methodology of the study. It is not uncommon to find that large-scale econometric models often fail to find a significant interest rate effect. This is because the interest rate effect on

lending channel of monetary policy transmission is one which has recently received much attention.

3.4. The Lending View of Monetary Policy Transmission

According to Kashyap and Stein (1993), the lending view of monetary policy transmission has, in one form or another, been around for some time. Much of the early work on the lending view, such as, Roosa (1951), Radcliffe's report (1959), Tobin and Brainard (1963), Brunner and Meltzer (1963) and Modigliani (1963), tends to focus on whether monetary policy works, in part, by changing the relative costs of bank loans and open-market paper, and whether such shifts in bank loan supply are accompanied by variations in the degree of non-price rationing.

Recent studies on the lending view, for example. Bernanke and Blinder (1988, 1990) and Kashyap, Stein, and Wilcox (1993), Kashyap and Stein (1993) and others, are quite different from those in the early days. These recent studies seem to give much less or perhaps even no importance to non-price credit rationing, and more to analyzing how monetary tightening through a banking reserve system affects the supply of banks loans and the following macroeconomic implications.

The lending view attempts to look into the so-called "black box" to search for a more complete explanation of how monetary policy affects the real economy. The lending view believes that imperfect information in the capital market may be a crucial factor in

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individual components of spending is either lost in the noise surrounding disaggregate data or already embodied in the endogenous explanatory variables. Duguay suggests that a small aggregative model is better suited to quantify the interest-rate effect of monetary policy than a large-scale econometric model.

explaining a propagation of monetary policy shocks to the real economy. The lending view argues that asymmetric information between borrowers and lenders leads to capital market imperfection.

One of the main features of capital market imperfection is imperfect monitoring, which renders the cost of external funds generally higher than the cost of internal funds (Bernanke and Gerlter,1989). The lending view contends that banks which have special access to monitoring technology can provide loans to some borrowers for whom the cost of alternative sources of funds is high (Diamond, 1984). As analyzed in the following chapter, the lending view's main point of departure from the conventional money view is its rejection of perfect substitutability of all financial assets, especially bank loans and bonds. The existence of the lending channel essentially hinges on the assumption that loans and bonds are not perfect substitutes.

According to Bernanke and Gertler (1995), the actions taken by the central bank can have real effects through two channels: the balance sheet channel and the bank lending channel.

3.4.a. The balance sheet channel

The balance sheet channel is based on a theoretical postulation that the external finance premium facing borrowers should depend on borrowers' financial positions. The stronger the financial position, the lower the external finance premium, defined as the difference in cost between funds raised externally and funds generated internally. The financial position is measured by borrowers' net worth, defined as the sum of their

liquid assets and marketable collateral. The balance sheet channel of monetary policy originates from the fact that changes in monetary policy affect not only market interest rates but also the financial situation of borrowers, both directly and indirectly.

3.4.a.i. Direct effect channel

A tight monetary policy directly weakens borrower balance sheets at least in two ways. First, a rise in interest rates would increase the interest rate cost of the borrower outstanding short-term or floating-rate debts, reducing net cash flows and weakening borrower financial positions. Second, rising interest rates are typically associated with declining asset prices, which among other things shrink the value of borrower collateral.

3.4.a.ii. Indirect effect channel

A tight monetary policy reduces customer spending, firm revenue will decline while various fixed and quasi-fixed costs (including interest and wage payments) do not adjust in the short-run. The result is an increase in the "financing gap" (the difference between firm uses and sources of funds), eroding firm net worth and creditworthiness.

As a matter of fact, the argument that monetary policy may affect firm balance sheets and financial situations is by no means new. It was raised before by Tobin(1969) in his "*q*" theory of investment and wealth effects on consumption, where "*q*" is defined as the market value of firms divided by the replacement cost. Tobin argues that monetary policy can affect the economy through its effect on equity. If *q* is high, the market price of firms is also high relative to the replacement cost of capital, new plant and equipment capital is cheap relative to the market value of business firms. Firms can

then issue equity with a high price. As a result, investment spending will increase as firms can purchase new investment goods with only a small issue of equity.

In Tobin's wealth effect model, a contractionary monetary policy implies the public has less money than it wants and hence has to cut its spending and investment, which include, inter alia, portfolio investment. With the lower demand for equity, the equity price is expected to fall. In a Keynesian context, a rise in the interest rate driven by monetary policy tightening would also make bonds more attractive relative to equity, thereby causing the prices of equity to fall. In short, lower equity prices will lead to a lower "*q*" and hence to lower investment spending.

Tobin's (1969) wealth effect theory was, in part, backed by Modigliani's (1975) life-cycle theory. In Modigliani's life-cycle model, consumption spending is determined by the life-time resources of consumers, which are made up of human capital, real capital and financial wealth. A major component of financial wealth is common stocks. When stock prices fall, so does the value of financial wealth, thereby decreasing the life-time resources of consumers and consumption.

Even if there are some similarities between the lending view' balance sheet effect and Tobin's wealth effect and Modigliani's life-cycle effect, the lending view appears to place more emphasis on the impact of monetary policy on firm external finance premium. Succinctly, the lending view argues that there are two reasons which explain why corporate cash flows and profits decline following a tightening of monetary policy. First, an increase in interest payments directly reduce firms' profit. Second, following a

monetary tightening, corporate income tends to fall more quickly than costs, causing a problem of cash flows.

The balance sheet channel's necessary conditions

The effects of the corporate cash flows on economic behaviour depend largely on the ability of firms to smooth the problem of cash flows by borrowing. Firms that have relatively poor access to credit markets may have to respond to the declining cash flows by cutting production and employment, while firms with good access to credit will face less financial pressure. The lending view argues that due to asymmetric information some firms, especially those with less established reputation, cannot borrow in open markets, so they have to rely on banks for finance. As a result, any monetary policy shocks that affect the supply of bank loans will have real effects.

3.4.b. The bank lending channel

The bank lending channel is based on the assumption of market imperfection that gives banks a unique and essential role in allocating the economy's financial resources. Unlike lenders in other markets such as a commercial paper market, banks are special in the sense that they have expertise in gathering information about borrowers, evaluating projects, and monitoring borrowers after the receipt of loans. The significance of this expertise is that some borrowers may only be able to borrow from banks as they are unable to borrow from other sources or can borrow only at increased costs. This means

that anything that disrupts normal banking activity can reduce the supply of loans to bank-dependent borrowers and thus have macroeconomic implications[6].

In most countries, small firms with little reputation are generally bank-dependent. In Thailand, for example, small firms are relatively more reliant on intermediated loans for financing than are larger firms. Table 3.1 shows that intermediated credit (mostly bank loans) accounts for almost 67 % of debt finance for firms with assets of less than one billion baht, compared to just around 13 % for large firms with assets over 10 billions baht.

Table 3.1:Composition of Industrial Firms' Debt Finance by Asset Size(as of June 1996)

Type of debt as % of total liabilities	Asset size (in billions of baht)				
	All	<1	1-4	4-10	10>
Overdrafts and loans from financial institutions	***18.65***	***66.85***	***47.8***	***34.93***	***12.75***
Trade accounts and notes payable	7.77	14.64	21.65	10.91	5.67
Debentures	7.33			15.42	6.17
Long-term liabilities	36.48	4.38	28.33	17.05	41.44
Loans and amount due to related parties	1.08	3.06	0.84	1.72	0.95
Other	28.69	11.07	1.38	19.97	33.02
Total	100	100	100	100	100

Source: The Stock Exchange of Thailand's Monthly Review

[6]For instance, the central bank sells government securities to the public in exchange for checks drawn on commercial banks. As the central bank debits the reserve accounts of these banks, reserves in the banking system will fall relative to deposits. If the reserves fall below the statutory reserve requirement, the banking system as a whole must reduce its holdings of deposits.

In the conventional money channel, there is no role for banks in monetary policy transmission; money is either the monetary base or directly proportional to the monetary base. Banks offer no special services on the asset side of their balance sheet. On the liability side of their balance sheet, banks perform a special role: the banking system creates money by issuing demand deposits (Hubbard, 1994).

In the IS-LM model, it is assumed that asset holders (households) have to choose between two types of assets: money and bonds. Money includes currency plus demand deposits which normally pay no interest, while bonds include all kinds of liquid assets, including bank loans. This implies that in order to dichotomize the markets into two markets, bonds and loans are lumped into one group of assets. The amalgamation of loans and bonds implies that they are assumed to be perfect substitutes.

Because of its restriction to a single portfolio equation representing all asset markets, the IS-LM money channel cannot recognize the operation of the lending channel. Agitating for monetary policy transmission via the lending channel, the lending view proposes a three-asset model. In this model, it is assumed that there are three assets: money, bonds, and loans. These three assets differ from each other in meaningful ways and must be accounted for separately when analyzing the impact of monetary policy shocks (a theoretical analysis of the three-asset model is presented in Chapter Four).

The bank lending channel's necessary condition

The impacts of monetary policy on the bank loan supply depend on the extent to which banks can replace lost (retail) deposits with other sources of funds, such as issuing certificates of deposit. The existence of the bank lending channel does not, however, require banks to be totally incapable of replacing lost deposits. It is only required that banks do not face a perfectly elastic demand for their managed liabilities(certificates of deposit), so that an open market sale by the central bank- which shrinks the banks' core deposit base and forces them to rely more on managed liabilities- also increases the banks' relative cost of funds (Kashyap and Stein, 1994). An increase in the cost of funds to banks should shift the supply of loans inward, squeezing out bank-dependent borrowers and raising the external finance premium.

Bernanke and Gerlter (1995) point out, despite financial deregulation and innovation, it remains likely that the demand for banks' managed liabilities is not perfectly elastic. This is because of, among other things, lack of deposit insurance, liquidity (many CDs are non-negotiable or difficult to trade on secondary markets). As a result, new investors will only be induced to hold CDs if they are paid higher interest rates. Nonetheless, with the advent of bank liability management (paying the public to switch more to less liquid bank liabilities), it is expected that the bank lending channel is likely to be less important than it was before.

In a nutshell, the existence of the bank lending channel depends on two key conditions. First, firms must not be able to offset a decline in the supply of bank loans by switching to borrow directly from the public in open markets. Second, the banking sector as a

whole must not be able to completely insulate its lending activities from shocks to reserves by switching from traditional deposits to less reserve-intensive forms of finance.

Although the lending view can be decomposed into two channels: the balance sheet channel and the bank lending channel, it is extremely difficult to carry out an empirical test that could conclusively separate the two (Bernanke and Gerlter, 1995). A tightening of monetary policy leads to not only a reduction in bank reserves but also a worsening of both firm and bank balance sheets. For example, if rising interest rates lower the value of securities, impairing bank capital, then the banks' ability to attract funds and hence their capacity to make loans may be limited. A rise in interest rates means borrowing from the public becomes more expensive as banks must promise a higher interest rate to sell their CDs.

Despite the fact that a clear distinction between the two channels of the lending view may be difficult to make, the existence of the lending channel whose foundation is based on market imperfection is relatively easier to identify. As discussed above, the existence of the lending view depends on the extent to which banks and firms can obtain funds in open markets. If funds can be raised freely and cheaply in open markets, or in other words, that is, the degree of information imperfection in the capital market decreases, the importance of the credit (or lending) channel is likely to diminish. In the lending view's three-asset model, for the lending channel to exist distinctively, it is required that bonds and loans must not be perfect substitutes.

In the above review, there is, in fact, another transmission channel which has not been discussed, that is, the exchange rate channel. In an open economy, changes in monetary policy can also be transmitted through changes in the exchange rate. Mundell (1963) and Fleming (1962) propose a well-known theoretical framework for analyzing the impact of monetary policy on the real economy through changes in the exchange rate. For example, they argue that when the domestic real interest rate rises, domestic currency becomes more attractive and entices capital inflows causing the domestic currency to appreciate. The higher value of the domestic currency makes domestic goods more expensive, thereby causing a fall in net export and hence output.

In the theoretical model to be developed in the following chapter, it will be assumed that the economy is a closed economy, so the exchange rate channel is excluded. The real wealth effect channel stemming from portfolio investment as suggested by Tobin(1969), Modigliani(1975), and to some extent Bernanke and Gertler(1995) will also be ignored. Firms, banks and households will be assumed to be separate entities.

Although households may earn their income from working in the corporate sector, they hold no equity in it. All corporate physical capital is assumed to be financed by borrowing, either directly through the issuance of commercial paper or indirectly through an intermediary. By putting aside the exchange rate channel and the real wealth effect channel, we are able to focus exclusively on the analysis of the lending channel, which is the main theme of this thesis.

3.5. Conclusion

The main feature of the conventional money view is that the central bank, through a change in its nominal supply of outside money, can affect nominal as well as real short-term interest rates, provided that prices do not adjust instantaneously. A policy-induced change in a real short-term interest rate somehow transmits to a change in a longer-term interest rate, thereby influencing household and business spending decisions. The money view does not, however, elucidate exactly how monetary policy affects the real economy. The money view's "incomplete" explanation of the transmission channel together with the lack of empirical support for the so-called "interest-sensitive" effect has led to a search for an alternative view of monetary policy transmission.

In recent years, the lending view of monetary policy transmission has received much attention, especially following studies by Bernanke and Blinder (1988, 1990) and Kashyap, Stein, and Wilcox (1993). The lending view stresses the existence of asymmetric information in the capital market and the role of bank loans in the monetary policy transmission. Even though the lending view can be decomposed into two channels: the balance sheet channel and the bank lending channel, the existence of these two channels or the lending view as a whole depends essentially on the fundamental assumption that bank loans and bonds are imperfect substitutes.

Chapter Four

The Lending View of Monetary Policy Transmission: A Theoretical Analysis

4.1. Introduction

In the previous chapter, the two views of monetary policy transmission have been conceptually expounded; one has long been established in most macroeconomic textbooks (the money view) and the other has recently received a revival of interest (the lending view). This chapter will develop a simple theoretical model to help understand the bank lending channel of monetary policy transmission. The three questions are to be addressed by the model developed in this chapter: first, how can the lending channel be distinguished from the conventional money channel?; second, is the lending channel an independent channel or merely an enhancement mechanism to the conventional money channel?; and third, what are the necessary conditions for the existence of the lending channel?

This chapter is organized into eight sections. Section 4.2 explains how the lending view can be distinguished from the conventional money channel. Section 4.3 establishes the conditions under which the lending channel will be a distinct channel or just an enhancement mechanism to the money channel. Section 4.4 analyzes the conditions required for the existence of the lending channel. Section 4.5 examines the implications of bank portfolio redistribution on the effectiveness of the lending channel. Section 4.6 describes the operation of the lending channel and the money channel in an open economy. Section 4.7 analyzes the role of credit rationing in monetary policy transmission through the lending channel. Section 4.8 concludes.

4.2. How Can the Lending Channel Be Distinguished from the Conventional Money Channel?

According to Kashyap and Stein (1993), the easiest way to define what the lending view means is to contrast the lending view with the simpler and better known money view. In the pure money view, there are two assets: money and bonds and one interest rate. This single interest rate is taken to be a summary statistic for all credit market conditions. That is, it is thought of as simultaneously capturing the return on all assets, such as, government bonds, bank loans, and real capital. The traditional IS-LM model's version of monetary transmission is one which can be regarded as a pure money view.

4.2.a. The conventional money view

In the traditional IS-LM money view of monetary policy transmission, a contractionary monetary policy is transmitted to the real economy through a change in the interest rate. For instance, assuming that the price level is constant, a decline in a monetary base leads to a fall in the supply of money stock, which in turn raises real interest rates and hence the cost of capital, thereby causing a decline in investment spending, aggregate demand and eventually output.

Bernanke and Blinder(1988) suggest that the easiest way to develop the lending view model is to modify the conventional IS-LM model to incorporate the lending view. So let us begin by briefly revisiting the IS-LM model.

4.2.a.i. Derivation of the IS and the LM Curves

Following Branson (1989) and Wells (1995), the IS and the LM curves are derived as follows.

Derivation of the IS curve

The IS curve represents the pair of the bond rate (r), and real income (y) that will keep the goods market in equilibrium. This equilibrium condition implies that

$$CE + I + G + NX = GNP = C + S + T + Rf \qquad (4.1)$$

where

CE≡ total value of (private) consumption expenditure

I≡ total value of investment expenditure

G≡ government expenditure

GNP = gross national product

NX≡ net export

S ≡ gross private saving

T ≡ net tax revenue

Rf ≡ total private transfer payments to foreigners

It is assumed for the moment that the economy is a closed economy (this assumption will later be relaxed). Therefore, net export, NX, and Rf become zero. It is also assumed that indirect business tax and capital depreciation are negligible and will be ignored. As a result, Y, national income, stands for both income and output.

The real equilibrium condition for a closed economy is

$$c + i + g = y = c + s + t \tag{4.2}$$

where $y\ (=\frac{Y}{P})$ is the standard symbol for the real national income or real GDP. Real (private) consumption expenditure, $c\ (=\frac{CE}{P})$, is assumed to be a function of real disposal income. Real tax, t, is assumed to be a function of real income.

(4.2) can be re-arranged as

$$y = c[y - t(y)] + i + g \tag{4.3}$$

or

$$y - c = s(y - t(y)) + t(y) = i + g \tag{4.4}$$

Investment demand is assumed to a decreasing function of the interest rate; i.e. $i(r)$, $i_r < 0$. For simplicity, it is assumed that the price level is constant, so the real and nominal interest rates are equal.

The goods market equilibrium condition is

$$IS: y = c[y - t(y)] + i(r) + g \tag{4.5}$$

Total differentiation of (4.5) yields

$$dy = c_y(1 - t_y)dy + i_r dr \tag{4.6}$$

$$0 < c_y, t_y < 1$$

The slope of the IS, holding g constant is

$$\frac{dr}{dy} = \frac{[1 - c_y(1 - t_y)]}{i_r} < 0 \tag{4.7}$$

Derivation of the LM curve

The LM curve represents the pairs of r and y that will keep the money market in equilibrium at a given level of money supply, M, and a given price level, P. Like any other market, the money market has both demand and supply sides. Real money demand is defined as

$$\frac{M^d}{P} = f(\underset{-}{r}, \underset{+}{y}) \tag{4.8}$$

The real money demand (4.8) is a pure transactions demand for money, and assumed to be a function of the interest rate (r) reflecting the opportunity cost of holding money and the real income or output (y) reflecting the transactions demand for money. In the IS-LM model, consumption, investment, and money demand functions do not include wealth as arguments. Conveniently, it is implicitly assumed in the IS-LM model that an increase in private wealth is allocated entirely to bonds, with no effects on either consumption or money holdings (Turnovsky, 1977: 40). In this study, it will be further assumed that households hold no equity, so Tobin's wealth effects through equity investment are excluded (sub-section 4.2.b.i will discuss in detail all assumptions concerned). In addition, as assumed earlier, the price level (P) is constant, so "real wealth effects" are also excluded.

The money market equilibrium is

$$\frac{M^S}{P} = \frac{M^D}{P} \tag{4.9}$$

$$\frac{M^S}{P} = m = f(\underset{-}{r}, \underset{+}{y}) \tag{4.10}$$

To derive the slope of the LM curve, we totally differentiate (4.10)

$$dm = f_r dr + f_y dy \tag{4.11}$$

$$dr = \frac{dm}{f_r} - \frac{f_y}{f_r} dy \tag{4.12}$$

The slope of the LM curve is

$$\frac{dr}{dy} = -\frac{f_y}{f_r} \tag{4.13}$$

Substituting (4.12) into (4.6) yields

$$dy = \frac{\frac{i_r}{f_r}}{[1 - c_y(1 - t_y)] + i_r \frac{f_y}{f_r}} dm > 0 \tag{4.14}$$

Equation (4.14) reflects the traditional IS-LM model's version of monetary policy transmission. In equation (4.14), changes in the money base lead to changes in the money supply. Changes in the money supply are transmitted to the goods market via changes in the interest rate[1]. In the conventional money view, there is no independent role for bank loans in monetary policy transmission. Reduced availability of bank loans does not matter because firms can supposedly maintain their spending by borrowing elsewhere(issuing bonds). In the IS-LM model, bonds and loans are implicitly assumed to be perfect substitutes[2].

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[1] Although it is admitted that many central banks since the 1980s have turned away from quantitative policy like open market operations to interest rate policy, it will be assumed that the monetary policy instrument is the central bank's open market operations in the bond market, directed towards changes in the stock of the money base. This assumption is made simply to keep our analysis within the orthodox IS-LM framework.

[2] The traditional theory of corporate finance pioneered by Modigliani and Miller (1958) also disregards bank loans. Bank loans are considered to be irrelevant to real decisions, such as, investment decisions,

4.2.b. The lending view

The lending view argues that owing to asymmetric or imperfect information in the capital market, bank loans and bonds are deemed imperfect substitutes, and hence cannot be lumped into one group of assets as in the conventional money view. The imperfect substitution between bank loans and bonds implies that there are three distinctive assets: money, bonds, and loans, and there are three markets: goods, money, and loan markets.

The goods market and the money market have already been introduced above. So in this section, the third market (the loan market) is to be introduced. But before introducing the loan market, it may be useful to clarify the economy-wide balance sheet upon which the lending view is based. This clarification will help to spell out any potential confusion which may arise from the lending view's reclassification of assets into three distinctive groups.

4.2.b.i. Simplified (closed) economy-wide balance sheet, definitions of the three assets, and related assumptions

In Table 4.1, the three assets are defined as follows:

Money includes currency plus demand deposits, assumed to pay no interest.

Loans are bank loans.

Bonds includes government bonds, commercial paper, and certificates of deposit[3].

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for any class of firms. Like the conventional IS-LM model, Modigliani and Miller's model depends on the assumption of perfect capital markets, with equal access for all firms and investors to equity finance.

[3] For simplicity, it is assumed that commercial paper represents all firms' debt instruments and certificates of deposit represents all banks' debt instruments(or managed liabilities). In the real world, both banks and firms can issue various kinds of debt instruments with various maturities and rates of interest to raise funds.

Table 4.1: Simplified Economy-Wide Balance Sheet

Central Bank		Banks		Firms		Households	
Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities
B^C	C^C	C^B	DD	K^F	L^F	C^H	L^H
	BD	BD	CD	C^F	CP.	DD	
		K^B				CP	
		B^B				CD	
		L				B^H	

where B ($=B^C+B^B+B^H$) = government bonds, BD = bank deposits with the central bank (part of bank reserve requirement), DD = demand deposits, CP = commercial paper, CDs = certificates of deposit (for the sake of neatness, hereafter CD), L ($=L^F+L^H$) = loans, K^B = bank physical capital, K^F = firm physical capital, and C ($=C^B+C^F+C^H$) = currency

Because of the lending view's fundamental three-asset assumption, it is implicitly assumed, although rather unrealistically, that commercial paper, certificates of deposit and government bonds are perfect substitutes, and hence their rates of return are assumed to be equal.

From the above balance sheet and definitions, the following assumptions are made

1. There are four sectors in the economy: the central bank, the banking sector, the corporate sector, and the household sector.

2. The government pursues a conservative fiscal policy leading to a balanced budget. As a result, the role of the government in monetary policy procedures is very minor, and will, therefore, be excluded. Though the budget is balanced, there are still

government bonds outstanding (i.e, bonds which were issued to finance the deficit in the past or "residual" bonds).

3. The household sector is a net lender, while the corporate sector is a net borrower. Although some households earn their income from working in the corporate sector, it is assumed that they hold no corporate shares. All corporate physical capital is financed by borrowing, either directly through the issuance of commercial paper or indirectly through intermediaries (i.e. banks). Let us think that the economy in this model constitutes largely small and medium sized firms which may be family-owned or not "publicly-traded" firms. Small and medium sized firms generally have limited internal finance, and tend to rely on banks for finance.

4. The household sector's earning is, in part, allocated to purchases of goods and services and the rest is put in bank deposits and invested in debt instruments. Since it is assumed that the government has no need to borrow from the public, it means that apart from government bonds outstanding, should the households want to invest in debt instruments, they are only able to invest in privately-issued debt instruments.

4.2.b.ii. Net wealth of the four sectors

Based on the above balance sheet, definitions, and assumptions, the four sectors' net real wealth is defined as follows:

The corporate sector's net wealth

$$W^F = K^F + C^F - L^F - \mathrm{CP}$$

The household sector's net wealth

$$W^H = C^H + \mathrm{DD} + \mathrm{CP} + \mathrm{CD} + B^H - L^H$$

The banking sector's net wealth

$$W^B = C^B + \text{BD} + B^B + \text{L} + K^B \text{ - DD - CD}$$

The central bank's net wealth

$$W^C = B^C \text{ - C - BD}$$

From the balance sheet, it can be seen that the central bank can influence the loan supply either by changing its holding of government bonds (B^C), i.e. open market operations, affecting bank deposits and reserves or altering credit to banks at the discount window. Since changes in the central bank's credit to banks and holding of government bonds are directly and indirectly conducive to changes in bank reserves and loan supply, they need to be elaborated.

4.2.b.iii. Bank reserve system, loan supply and money supply mechanism

Reserve system and loan supply

The central bank normally has three ways of influencing the loan supply, all operating through the reserve mechanism: open market operations, discount window lending, or changes in the reserve requirement ratio.

The total reserves (TR) of the banking system consist of required reserves (RR) and excess reserves (RE).

$$\text{TR} = \text{RR} + \text{RE} \qquad (4.15)$$

Sometimes due to unanticipated flows of funds or because it is profitable, banks may find that reserves are below the required level, and thus they have to borrow reserves from the central bank. As a result, total reserve can be decomposed into non-borrowed reserves (RU) and borrowed reserves (RB):

$$TR = RU + RB \tag{4.16}$$

The central bank supplies borrowed reserves (RB) through the discount window and unborrowed reserves (RU) through the repurchase market or the bond market[4]. Banks can allocate the reserves to required reserves (RR) and to excess reserves (RE). Some of the reserves provided by the central bank through open market purchases of bonds may end up as currency in the hands of the households (C^H). Hence, (4.16) can be expressed as

$$RU + RB = TR = RR + RE + C^H \tag{4.17}$$

or

$$RU = RR + (RE - RB) + C^H = RR + RF + C^H \tag{4.18}$$

where RF (= RE-RB) is net free reserves

It is assumed that banks are required to hold part of their required reserves (RR) in the form of no-interest-bearing deposits at the central bank (BD) and the rest in the form of government bonds (B^B).

Reserve system and money supply

Following Branson (1989), let h be the ratio of public demand for holding money, defined as

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[4] When banks borrow from the central bank at the discount window, they place bonds as collateral in return for credit which will be put in their deposits (BD) at the central banks. In the above central bank's balance sheet, an increase in the central bank credit (or borrowed reserves) results in a rise in B^C and BD. A similar result can also be achieved by the central bank's open market purchases of government bonds in the repurchase market or the bond market.

$$C = hM1 \tag{4.19}$$

where M1 = money supply

Let z be the ratio of reserve requirement, defined as

$$RR = zDD = z(1-h)M1 \tag{4.20}$$

where z is a statutory reserve requirement ratio

Unborrowed reserves can be expressed as

$$RU = z(1-h)M1 + RF + hM1 \tag{4.21}$$

Solving for M gives the following money supply equation,

$$M1 = \frac{RU - RF}{[z + h(1-z)]} \tag{4.22}$$

$$\frac{\partial M}{\partial RU} > 0, \frac{\partial M}{\partial RF}, \frac{\partial M}{\partial h}, \frac{\partial M}{\partial z} < 0 \tag{4.23}$$

From equation (4.22), the public can influence the money supply via changes in *h*. Commercial banks influence the money supply through their decision on excess reserves (RE) and borrowed reserves (RB), which, in turn, determines RF(=RE-RB). The central bank influences the money supply via changes in RU and RR (which affects *z* in the multiplier). Changes in RU may originate from the central bank's open market operations either in the repurchase market or the bond market or possibly both.

Having defined the three assets, net wealth of the four sectors and the money supply mechanism, we can now examine the loan market.

4.2.b.iv. The loan market

Like the money market, the loan market has both demand and supply sides.

Loan demand

It is assumed that firms' demand for loans is the difference between planned accumulation of physical and financial assets and their saving[5].

$$L^D(\underset{-}{r^L},\underset{-}{r},\underset{+}{y}) = \{I(\underset{-}{r^L},\underset{-}{r}) + M^D(\underset{-}{r},\underset{+}{y})\} - S(\underset{+}{y}) \qquad (4.24)^6$$

where S denotes saving. I denotes investment demand and is assumed to be a function of the loan rate and the bond rate, reflecting firms' choice of financing. M^D denotes firms'(transaction) money demand. It is assumed that firms have to pay at least some of their production factors before they receive their revenues, so they need some liquidity in the form of money. The higher the liquidity, the smoother the production process (Ramey,1993).

In the absence of depreciation, the term in the curly brackets is a planned net accumulation of physical and financial assets. In equation (4.24), an increase in income gives rise to two conflicting effects: it increases saving and hence the capacity of self-financing which reduces borrowing, but it also increases the demand for real money balances which raises the demand for borrowing. Let us assume that the latter effect dominates (Papademos and Modigliani, 1990) and (Wells, 1995).

---

[5] In most of the literature on the lending view, the behaviour of firms is the focus of theoretical analysis. However, this does not mean that the lending channel does not have impacts on households. *"The credit market frictions that affect firms should also be relevant to the borrowing and spending decisions made by households, particularly spending on costly durable items, such as, automobiles and houses"* (Bernanke and Gertler, 1995, page 44). For the sake of simplicity, our theoretical analysis will only focus on firms' loan demand.

Loan supply

The loan supply function derives from bank profit maximization in which the loan supply is assumed to be a negative function of the bond rate, the opportunity cost of bank lending, but a positive function of the loan rate.

$$L^S(\underset{+}{r^L};\underset{-}{r},\underset{+}{m}) \tag{4.25}$$

The loan supply function (4.25) is specifically assumed to be a function of the real money supply, rather than the real money base. This assumption, in turn, implies that the money multiplier is assumed to be, more or less, constant or stable. As derived below, this assumption is made for the sake of convenience to embed the loan market in the goods market. By assuming that the money multiplier is constant or stable, changes in the monetary base are directly conducive to changes in the money supply.

The loan market equilibrium is

$$L^D(\underset{-}{r^L};\underset{-}{r},\underset{+}{y}) = L^S(\underset{+}{r^L};\underset{-}{r},\underset{+}{m}) \tag{4.26}$$

Taking the total derivative of equation (4.26), we obtain

$$dr^L = \Phi\left[\left(\frac{\partial L^S}{\partial r} - \frac{\partial L^D}{\partial r}\right)dr + \frac{\partial L^S}{\partial m}dm - \frac{\partial L^D}{\partial y}dy\right] \tag{4.27}$$

where $\Phi = \dfrac{1}{\left(\dfrac{\partial L^D}{\partial r^L} - \dfrac{\partial L^S}{\partial r^L}\right)}$

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6 Loan demand (L^D) and money demand (M^D) in (4.24) are flow variables. For convenience, a change sign (Δ) is suppressed.

Since $\frac{\partial L^D}{\partial r^L} < 0, \frac{\partial L^S}{\partial r^L} > 0$, each term of the denominator of equation (4.27) is negative. The third term on the right-hand side is positive as $\frac{\partial L^D}{\partial y} > 0$. That is, at a given level of bank reserves, a rise in the real income or output puts upward pressure on the loan rate. The second term is also negative as $\frac{\partial L^S}{\partial m} > 0$, reflecting what is inferred in the above money supply mechanism. The sign of the first term depends on whether ($\frac{\partial L^S}{\partial r}$<0) is greater or less than ($\frac{\partial L^D}{\partial r}$<0). Let us assume the latter dominates, so that a rise in the bond rate leads to a rise in the loan rate.

Derivation of the CC curve

From equation (4.27), we have

$$r^L = r^L(\underset{+}{r}, \underset{+}{y}, \underset{-}{m}) \qquad (4.28)$$

The introduction of the bank loan market makes it necessary to modify the traditional IS-LM model. Following Bernanke and Blinder (1988), the IS curve is modified to incorporate the loan market into the goods market.

Substituting equation (4.28) into the investment function in equation (4.5) results in

CC (credit and commodity): $y = c[y - t(y)] + i\,[r, r^L(r,y,m)] + g \qquad (4.29)$

In equation (4.29), the investment demand is a function of not only the bond rate but also the loan rate. The incorporation of the goods and the loan markets makes it possible to represent the three markets: goods, money, loan markets by the two schedules (CC and LM curves), which can be plotted in a two-space diagram.

Totally differentiating equation (4.29) yields

$$dy = c_y(1-t_y)dy + (\frac{\partial i}{\partial r} + \frac{\partial i}{\partial r^L}\frac{\partial r^L}{\partial r})dr + (\frac{\partial i}{\partial r^L}\frac{\partial r^L}{\partial y})dy + (\frac{\partial i}{\partial r^L}\frac{\partial r^L}{\partial m})dm + dg \qquad (4.30)$$

Substituting equation (4.12) into equation (4.30), while keeping g constant, we have

$$dy = \Omega\left[\frac{\partial i}{\partial r}\frac{1}{f_r} + \frac{\partial i}{\partial r^L}\frac{\partial r^L}{\partial r}\frac{1}{f_r} + \frac{\partial i}{\partial r^L}\frac{\partial r^L}{\partial m}\right]dm \qquad (4.31)$$

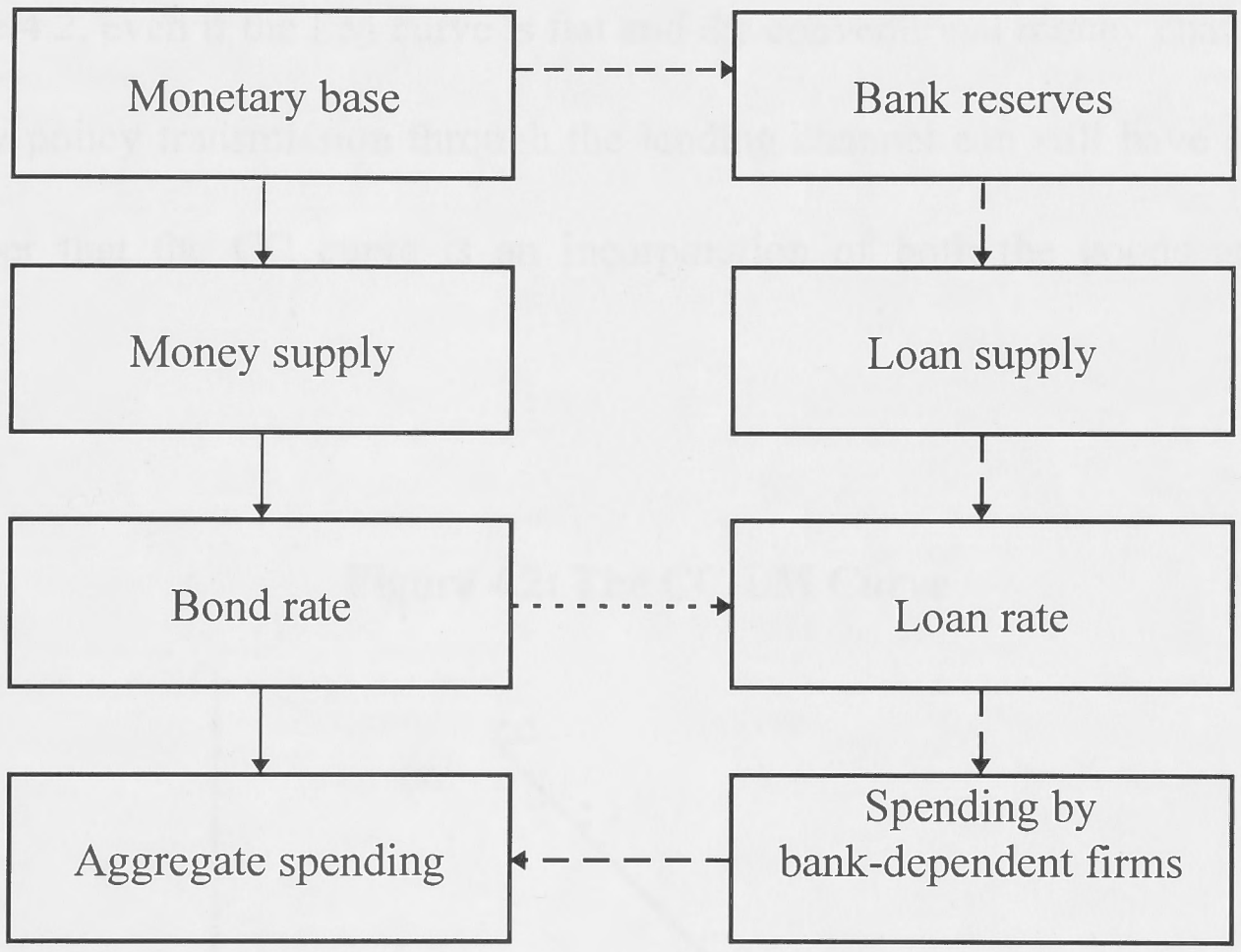
$$\text{where } \Omega = \frac{1}{[1-c_y(1-t_y)] - (\frac{\partial i}{\partial r^L}\frac{\partial r^L}{\partial y}) + \frac{f_y}{f_r}\phi]}$$

$$\phi = \frac{\partial i}{\partial r} + \frac{\partial i}{\partial r^L}\frac{\partial r^L}{\partial r} < 0$$

The first term in equation (4.31) corresponds to the solid arrows in Figure 4.1; it reflects the conventional money view of monetary policy transmission and is analogous to the multiplier effect in the pure money channel model equation (4.14). The second term in equation (4.31) can be considered as an "interest rate" lending channel, and corresponds to the dotted arrow in Figure 4.1. This "interest rate" channel reflects the impact of changes in the bond rate (or the central bank's open market rates) on the loan rate. The third term in equation (4.31) can be regarded as a "reserve" lending channel,

and corresponds to the dashed arrows in Figure 4.1. This "reserve" channel can also be related to the loan supply function (4.25) and the money supply equation (4.22).

Figure 4.1: Monetary Policy Transmission Channel

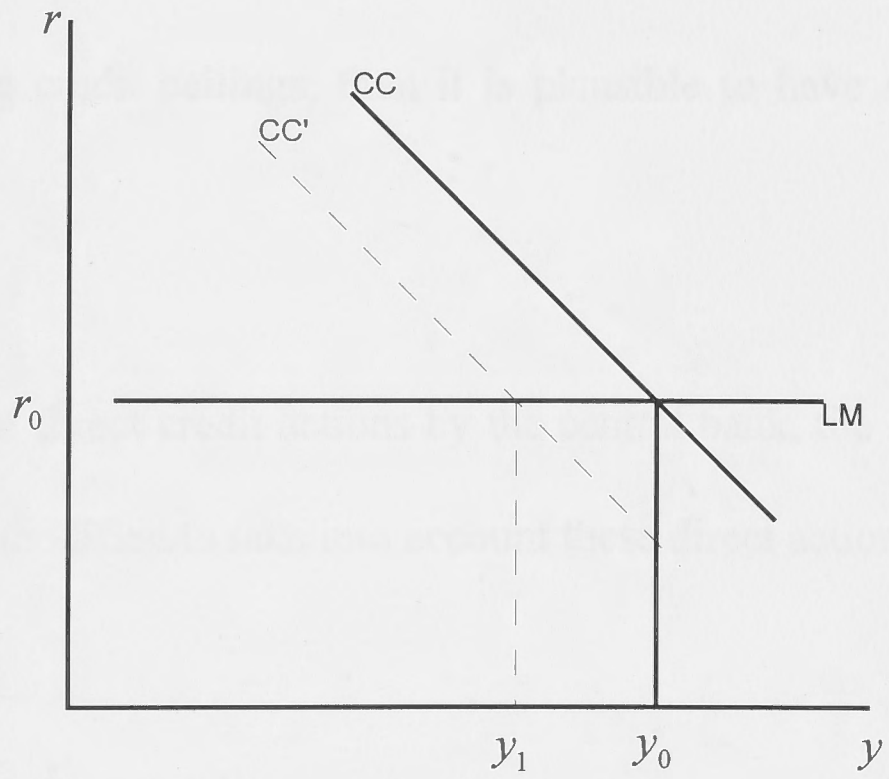


As pointed out by Kashyap and Stein (1993), to see the distinction between the money channel and the lending channel, one can take an extreme case in which the households view bonds and money as very close substitutes. In this case, a decrease in the money base which leads to a decline in the money supply will have a minimal impact on the bond rate (that is, the LM curve is very flat). The conventional money channel is, thus, attenuated. However, through the lending channel monetary policy transmission can still be effective, even when the LM curve becomes horizontal, i.e. $\frac{dr}{dy} = -\frac{f_y}{f_r} \to 0$ as $f_r \to \infty$. In equation (4.31), if $f_r \to \infty$, then

$$\frac{dy}{dm} = \frac{\frac{\partial i}{\partial r^L}\frac{\partial r^L}{\partial m}}{[1-c_y(1-t_y)]-(\frac{\partial i}{\partial r^L}\frac{\partial r^L}{\partial y})} > 0 \qquad (4.32)$$

In Figure 4.2, even if the LM curve is flat and the conventional money channel is weak, monetary policy transmission through the lending channel can still have a real effect. Remember that the CC curve is an incorporation of both the goods and the loan markets.

Figure 4.2: The CC-LM Curve



4.3. Is the Lending Channel a Distinct Channel or just an Enhancement Mechanism to the Conventional Money Channel?

In equation (4.32), the real effect of monetary shocks arises from an increase in the loan rate. In Figure 4.1, a rise in the loan rate could be the result of either a rise in the bond rate or a fall in bank reserves[7]. Therefore, one can argue that the lending channel may

[7] The central bank sells government bonds to the public in exchange for a check drawn on commercial banks. As the central bank debits the reserve accounts on these banks, reserves in the banking system fall

be merely a supplement, not an alternative channel to the conventional money channel. Bernanke and Blinder (1992) and Bernanke and Gertler (1995) are among advocates of the lending view who believe that the lending channel is just an enhancement mechanism of the conventional money channel, not a truly independent channel, whereas Kashyap, Stein, Wilcox (1993), Kashyap and Stein (1993) believe otherwise[8].

The crux of this conflicting view may stem from the way in which monetary policy is implemented. In Figure 4.1, the lending channel can be a truly independent channel, if changes in monetary policy directly affect the loan supply and cause a "credit crunch". For instance, if the central bank is prepared to reduce the supply of loans more directly, say, by imposing credit ceilings, then it is plausible to have an independent lending channel.

In the presence of direct credit actions by the central bank, the loan supply in equation (4.26) should be modified to take into account these direct actions.

$$L^D(\underset{-}{r^L};\underset{-}{r},\underset{+}{y}) = L^S(\underset{+}{r^L};\underset{-}{r},\underset{+}{m},\underset{-}{m^*}) \qquad (4.33)$$

relative to deposits. If reserves fall below the central bank's legal reserves requirement, the banking system as a whole must reduce its holdings of deposits, and this will affect the banking sector lending capacity. In equation (4.14), at a given price level, a fall in money supply means a fall in real money balances. To restore equilibrium, the real interest rate on bonds must rise.

8 The term "enhancement" and "independent" are often used in the literature without explicit definition. In our model, the enhancement mechanism of the lending channel can be inferred from Figure 4.1. Under conventional open market operations, changes in the monetary base automatically affect bank lending through changes in bank reserves and the loan rate. However, by imposing direct credit ceilings, the central bank can bypass the conventional mechanism shown in Table 4.1 and directly bring down the supply of bank loans (chapter six will discuss this issue in greater detail).

where m^* denotes a one-off direct credit action by the central bank. It could represent any regulatory actions by the central banks, such as a credit ceiling or a rise in the reserve requirement ratio.

Taking the total derivative of equation (4.33), we obtain

$$dr^L = \Phi\left[\left(\frac{\partial L^S}{\partial r} - \frac{\partial L^D}{\partial r}\right)dr - \frac{\partial L^D}{\partial y}dy + \frac{\partial L^S}{\partial m}dm + \frac{\partial L^S}{\partial m^*}dm^*\right] \tag{4.34}$$

where $\Phi = \dfrac{1}{\left(\dfrac{\partial L^D}{\partial r^L} - \dfrac{\partial L^S}{\partial r^L}\right)}$

From equation (4.34), we have

$$r^L = r^L(\underset{+}{r}, \underset{+}{y}, \underset{-}{m}, \underset{+}{m^*}) \tag{4.35}$$

Substitute equation (4.35) into the investment function in equation (4.5), and then follow the same procedure as shown in equations (4.30) and (4.31), we obtain

$$dy = \Omega\left[\left(\frac{\phi}{f_r} + \frac{\partial i}{\partial r^L}\frac{\partial r^L}{\partial m}\right)dm + \frac{\partial i}{\partial r^L}\frac{\partial r^L}{\partial m^*}dm^*\right] \tag{4.36}$$

In equation (4.36), monetary policy transmission through the lending channel is direct because it does not depend on how much, or whether, the bond rate (denoted by r) rises. Suppose that the "interest rate" channel and the "reserve" channel failed to affect the loan rate and the loan supply, the first term in the numerator of equation (4.36) becomes zero, but a tight monetary policy can still have real effects through its direct impact on

the supply of bank loans. As a result, the lending channel could operate independently of and concurrently with the money channel. When both channels are operating, they should reinforce each other[9].

Here we have to make it clear that we are (theoretically) discussing how the lending channel can work independently; whether or not direct credit actions are desirable policy choices is another matter. In many countries, the advent of financial liberalization means that many direct credit actions have become obsolete and undesirable due to their economic distortions[10].

As discussed above, the foundation of the lending view is based on the fundamental assumption of market imperfection which gives banks a unique and important role in allocating the financial resources of the economy. Any shocks affecting the ability of banks to provide intermediary services or affecting the cost of intermediation will have real effects. However, to have an effective lending channel, certain conditions must be met.

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9 Since the 1980s, many central banks have turned away from quantitative policy, such as, open market operations to interest rate policy. For example, rather than instructing its money traders to purchase or sell a particular quantity of bonds, the central bank instructs its dealers to stand ready to trade at a particular bond price, or equivalently, a particular interest rate (Wells, 1995). This interest rate policy will affect the whole structure of interest rates, including the loan rate. This change in monetary policy procedure, however, does not affect our conclusion about the possibility of an independent lending channel, which is centred at the central bank's direct credit actions.

10 In spite of their immediate effects, direct credit actions, such as, credit ceilings, make it difficult for certain borrowers to obtain loans, or force particular borrowers to pay a premium for funds that is not justified by difference in risk. Certain borrowers are dissuaded from undertaking investment simply because of the lack of funds. Thus, any direct credit action may merely create an inefficiency in the provision of credit (Romer and Romer, 1993). Generally, one of the main objectives of financial deregulation is to address any inefficiency in the provision of financial resources, and this is why direct credit actions are often deemed undesirable.

4.4. What Conditions Are Required for the Existence and Effectiveness of the Lending Channel?

According to Bernanke and Blinder (1988) and Kashyap and Stein (1993), the following two conditions are deemed necessary for the existence and effectiveness of the lending channel.

C1: Intermediated loans and open-market bonds must not be perfect substitutes on the liability side of firm balance sheets, so that firms are unable to offset a decline in the supply of bank loans simply by borrowing more directly from the household sector in the open market.

C2: The central bank must be able to affect the bank loan supply by changing the quantity of reserves available to the banking system. That is, the banking sector as a whole must not be able to completely insulate its lending activity from shocks to reserves, either by switching from traditional deposits to less reserve-intensive or reserve-free forms of finance or by running down its net holding of bonds[11]

Though C1 and C2 can be set as separate conditions, they are, in a broader sense, "the same". In the lending view's three-asset model, what is actually implied in C1 and C2 is that bonds and bank loans must not be perfect substitutes. In C1, if firm-issued bonds (for example, commercial paper) and loans are perfect substitutes, then bonds and loans

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[11] Strictly speaking, for C2 to hold, it must also be assumed that banks do not or cannot engage in off-balance sheet transactions. In the lending view model, it is implicitly assumed that there are no non-bank intermediaries or if there are, they only play a very minor role in the financial market. So, potential borrowers cannot respond to changes in monetary policy by turning to non-bank intermediaries for financing, and depositors cannot shift their assets between bank and non-bank institutions.

can be lumped into one group of assets as in the traditional IS-LM model and investment demand will be a function of a single interest rate, represented by the bond rate. In equation (4.29), this means that the CC curve reduces to the conventional IS curve.

In (4.31), if investment demand is not determined by the loan rate, then $\frac{\partial i}{\partial r^L}=0$ and consequently equation (4.31) reduces to equation (4.14), and the lending channel collapses to the money channel. In the three-asset model, it is implicitly assumed, although rather realistically, that private bonds and public bonds are perfect substitutes, (i.e. differences in risk and liquidity are ignored). As a result, if commercial paper is a perfect substitute for bank loans, so are certificates of deposit, and vice versa. In equation (4.31), if C2 does not hold, then the loan rate is not determined by the real money supply, i.e. $\frac{\partial r^L}{\partial m}=0$.

In equation (4.27), there are two possibilities that changes in the money supply may fail to affect the loan supply and hence the loan rate. One possibility is $\frac{\partial L^S}{\partial m}\to 0$, i.e. the loan supply is not influenced by changes in the real money stock; this possibility can refer to the dashed arrows in Figure 4.1. The other possibility is that either $\frac{\partial L^D}{\partial r^L}\to -\infty$ or $\frac{\partial L^S}{\partial r^L}\to \infty$. According to Bernanke and Blinder (1988), if loans and bonds are perfect substitutes either for borrowers ($\frac{\partial L^D}{\partial r^L}\to -\infty$) or for lenders($\frac{\partial L^S}{\partial r^L}\to \infty$), the CC curve

reduces to the IS curve. In our model, it means that equation (4.31) will reduce to equation (4.14), as $\frac{\partial r^L}{\partial m}$ and $\frac{\partial i}{\partial r^L}$ become zero.

Although C1 and C2 may be "the same" in the broader sense (i.e one implies the other), they need to be carefully analyzed. C1 only requires that loans and bonds must not be perfect substitutes on the liability side of firm balance sheets[12]. C2 requires that loans and bonds must not be perfect substitutes on both the liability and asset sides of bank balance sheets. As explained in the following section, as far as monetary policy implementation is concerned, C2 is especially important since it is directly linked to monetary policy procedure.

In addition, by virtue of the three-asset assumption in which publicly and privately-issued bonds are assumed to be perfect substitutes, in order to establish that the lending channel does exist, one only needs to establish that either of these bonds is not a perfect substitute for bank loans. This can be done in the following section by analyzing banks' portfolio which constitutes both government bonds and bank-issued "bonds".

Kashyap and Stein (1993) contend that monetary policy shocks will affect the loan supply, if banks are unable to avoid tight monetary policy either by selling government bonds or issuing their own "bonds". The former is a case of asset management, while

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12 Diamond (1991) proposes a theoretical model examining firms' choice between bank loans and directly placed debt (bonds). He concludes, among other things, that due to imperfect information in the capital market, new firms begin financing their investment by borrowing from banks with being subject to monitoring. Once these firms' reputation becomes well-established, they will begin directly borrowing from the public without being subject to bank monitoring.

the latter is a case of liability management. To analyze the impact of bank portfolio redistribution on the effectiveness of the lending channel, we now turn to a profit maximizing model of bank behaviour.

4.5. The Implications of Bank Portfolio Redistribution on the Existence and Effectiveness of the Lending Channel

To see the impact of bank portfolio redistribution on the existence and effectiveness of the lending view, we will utilize the principle of bank profit maximization and make assumptions as follows:

1. There is perfect competition in the central bank's open market for bonds, but imperfect competition in the loan market. Thus, in the open market for bonds, a representative bank is a price-taker, while in the market for loans, it is a price-setter. This assumption implies a monopolistic competition in which each bank faces a downward sloping demand curve for its loans and has to choose the loan rate so as to maximize its profit[13].

2. The bank holds two earning assets: open market securities (bonds) and loans and takes two kinds of deposits: demand deposits (DD) and certificates of deposit (CD).

3. Although demand deposits (DD) pay no interest, providing services for the deposits incurs some cost, assumed to be a fixed proportion of the deposits denoted by ψ. For

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[13] It is assumed that the banking sector in this model has a high degree of concentration in which a few big banks control most of the market share, but none of them has absolute monopoly power. In Thailand, for example, there are 15 banks, but the four largest banks control around two-thirds of the market share.

simplicity, all the bank's other operational costs, such as labour costs, are ignored as they are irrelevant to our analysis.

4. While DD are subject to a statutory reserve requirement, CD may or may not be subject to the requirement. For the moment, we assume that CD are subject to a reserve requirement; later we will discuss the impact, if this assumption is to be relaxed.

5. The bank's capital is assumed to be fixed, so the bank is supposed to offset any uncertain flows of deposits by either liquidating government bonds (B^B) or issuing its own "bonds" (CD). The operational costs of these two transactions are assumed to be negligible, and hence ignored.

From Table 4.1, a representative bank's balance sheet is

$$L + B^B + C^B + BD + K^B = DD + CD \tag{4.37}$$

where L = loans made by the bank to the public sector; B^B = government bonds held by the bank; C^B = currency held by the bank; BD = bank deposits at the central bank; DD = demand deposits help by the public; CD = certificates of deposit held by the public; and K^B = bank capital

The bank is subject to two types of reserve requirements

$$z^D \text{ DD} + z^C \text{CD} \leq \text{BD} \tag{A}$$

and

$$1\,v(DD + CD) \leq B^B \qquad \text{(B)}$$

Because of the zero rate of return on deposits at the central bank, we assume that the first of these requirements is satisfied as an equality, and that any excess reserves are held in the form of government bonds.

Equation (4.37) can be rewritten as

$$\text{L} + B^B + C^B + K^B = \text{DD} + \text{CD} - z^D\,\text{DD} - z^C\,\text{CD} \qquad \text{(4.37a)}$$

where $z^D\,\text{DD} + z^C\,\text{CD} = \text{BD}$

Equation (4.37a) can be re-arranged as

$$B^B = \text{DD} + \text{CD} - z^D\,\text{DD} - z^C\,\text{CD} - C^B - K^B - \text{L} \qquad \text{(4.37b)}$$

With the requirements stipulated above, the bank's profit per period can be written as

$$\Pi = r^L L + rB^B - \varphi DD - r^C CD$$

$$= r^L L(r^L) + r[DD + CD - z^D DD - z^C CD - C^B - K^B - L(r^L)] - \psi DD - r^C CD \qquad (4.38)$$

where $L(r^L)$ = the volume of loans demanded (for simplicity, assumed to be a function of the loan rate only); r^L = the loan rate; r^C = the CD rate; r = the bond rate; and ψ = the fixed cost of providing demand deposits

Subject to a liquidity constraint

$$L(r^L) \leq DD + CD - z^D DD - z^C CD - v(DD + CD) - C^B - K^B \tag{4.39}$$

where this constraint has been derived by substituting equation (A) and equation (B) into equation (4.37a). If equation (B) holds as an equality, so does equation (4.39).

The function to be maximized is

$$F = r^L L(r^L) + r[DD + CD - z^D CD - z^C CD - C^B - K^B - L(r^L)] - \psi DD - r^C CD$$
$$+\lambda [DD + CD - z^D DD - z^C CD - v(DD + CD) - C^B - K^B - L(r^L)] \tag{4.40}$$

Kuhn-Tucker's first-order conditions are

$$\frac{\partial F}{\partial r^L} = r^L \frac{\partial L(r^L)}{\partial r^L} + L(r^L) - r\frac{\partial L(r^L)}{\partial r^L} - \lambda \frac{\partial L(r^L)}{\partial r^L} \leq 0 \tag{4.41}$$

$$r^L \geq 0 \quad \text{and} \quad r^L \frac{\partial F}{\partial r^L} = 0 \tag{4.42}$$

$$\frac{\partial F}{\partial r^C} = r\frac{\partial CD}{\partial r^C} - rz^C \frac{\partial CD}{\partial r^C} - r^C \frac{\partial CD}{\partial r^C} - CD + \lambda \frac{\partial CD}{\partial r^C} - \lambda z^C \frac{\partial CD}{\partial r^C} - \lambda v \frac{\partial CD}{\partial r^C} \leq 0 \tag{4.43}$$

$$r^C \geq 0 \quad \text{and} \quad r^C \frac{\partial F}{\partial r^C} = 0 \tag{4.44}$$

$$\frac{\partial F}{\partial \lambda} = DD + CD - z^D DD - z^C CD - L(r^L) - v(DD + CD) \geq 0 \tag{4.45}$$

$$\lambda \geq 0 \quad \text{and} \quad \lambda \frac{\partial F}{\partial \lambda} = 0 \tag{4.46}$$

There are two possible outcomes depending on whether or not the liquidity constraint is binding.

4.5.a. Non-binding liquidity constraint

If the constraint is not binding, then equation (4.45) holds as an inequality and $\lambda = 0$.

The first-order conditions equations (4.41) and (4.43) become

$$\frac{\partial F}{\partial r^L} = r^L \frac{\partial L(r^L)}{\partial r^L} + L(r^L) - r\frac{\partial L(r^L)}{\partial r^L} = 0$$

which implies $r^L(1+\frac{1}{e_L}) = r$, (4.47)

and $\frac{\partial L}{\partial r^L} = \frac{L(r^L)}{(r - r^L)} < 0$ (4.47*)

where e_L denotes the elasticity of loan demand, and

$$\frac{\partial F}{\partial r^C} = r\frac{\partial CD}{\partial r^C} - rz^C\frac{\partial CD}{\partial r^C} - r^C\frac{\partial CD}{\partial r^C} - CD = 0 \quad (4.48)$$

$$\text{or } r = \frac{r^C(1+\frac{1}{e_C})}{(1-z^C)}$$

where e_C denotes the elasticity of demand for CD.

In equation (4.47), the loan rate is set where the marginal revenue from loans is equal to the marginal opportunity cost of lending, the bond rate. In equation (4.47*), we know that the loan rate should at least be marginally higher than the bond rate, otherwise banks would wholly invest in bonds and supply no loans. Although bonds yield a lower rate of return than loans, banks generally hold bonds above the legally required level in order to shield their loan supply from a short-run fluctuation of funds.

In the money supply equation (4.22), banks can offset a decline in unborrowed reserves (RU) by either selling excess bonds in the repurchase market (that is, squeezing excess

reserves (RE)), or increasing borrowing at the discount window by placing bonds as collateral (that is, increasing borrowed reserves (RB)). In an extreme case where a fall in RE and a rise in RB are sufficient enough to offset a fall in RU, the loan supply function (4.25) is not influenced by changes in the real money supply; this scenario can refer to the dashed arrows in Figure 4.1.

To discourage banks from substituting from bonds into loans, the cost of borrowing in the central bank's reserve market must not be the same as the interest rate earned on government bonds. In other words, banks must pay a premium when entering the central bank's reserve market as a borrower. Lower liquidity will increase the probability that the bank will have to enter the market as a borrower, which will, in turn, increase the marginal cost of funds.

To see how the borrowing premium can affect bank lending behaviour, we simplify equation (4.37a) by assuming that there is one type of deposits denoted by D with a proportion of D, denoted by z, held as zero-yielding deposits at the central bank and a proportion, v , held as bonds, i.e. zD + vD = total required reserves. It should be noted that on the basis of profit maximization, banks will never choose to hold deposits at the central bank (BD) above the required level as BD earn no interest; BD should thus be strictly equal to zD. However, banks are likely to hold bonds above the required level as a bulwark against an unanticipated shortfall of deposits, i.e. $B^B \geq vD$. If $B^B > vD$, this implies that total bank reserves consist of both required reserves and excess reserves.

Equation (4.37) can now be written as

$$L + B^B + C^B + K^B + BD = D \tag{4.37c}$$

Following Tobin (1982) and King (1986), let x be a random component of deposits with mean zero and $x \geq -1$. Also let $f(x)$ be the density function and F(X) be the probability distribution function that $x \leq X$ with F(-1) = 0. At the beginning of the period, the bank is assumed to know the distribution of x, but not its realization.

Equation (4.37c) becomes

$$L + B^B + C^B + K^B = D(1-z)(1+x) \tag{4.37d}$$

If the net bond holding, is, at least, at the required level (i.e. $B^B = vD$), a net return of r is obtained, but if below the required level ($B^B < vD$), the cost of short-term borrowing to meet the legal reserve requirement is incurred. It is assumed that the borrowing cost exceeds r by a premium b. According to Tobin (1982) and King (1986), the position of the net bond holding depends on the random component of deposits (x).

For given L, the critical value of x at which the net excess bond holding becomes zero (or $B^B = vD$) is given by

$$X = \frac{(vD + L + C^B + K^B)}{D(1-z)} - 1 \tag{4.37e}$$

Equation (4.37e) is derived from (4.37d) where $B^B = vD$.

If the bank is risk neutral, it will choose to maximize the expected profit:

$$F = r^L L(r^L) + r[D(1-z) - C^B - K^B - L(r^L)] - r^D D$$
$$+b\int_{-1}^{\frac{(vD+L+C^B+K^B)}{D(1-z)}-1} [D(1-z)(1+x) - C^B - K^B - L(r^L)]f(x)dx \qquad (4.37f)$$

where r^D = a deposit rate

The last term of equation (4.37f) captures the expected cost of entering the central bank's reserve market as a borrower.

Differentiating equation (4.37f) with respect to r^L using Leibnitz's rule, yields

$$\frac{\partial F}{\partial r^L} = r^L \frac{\partial L}{\partial r^L} + L(r^L) - r\frac{\partial L}{\partial r^L} - \frac{\partial L}{\partial r^L} b\left\{F\left[\frac{(vD+L+C^B+K^B)}{D(1-z)} - 1\right] - \frac{v}{(1-z)}\right\} = 0 \qquad (4.37g)$$

After some simple manipulation, we obtain

$$r^L\left(1+\frac{1}{e_L}\right) = r + b\left\{F\left[\frac{(vD+L+C^B+K^B)}{D(1-z)} - 1\right] - \frac{v}{(1-z)}\right\} \qquad (4.37h)$$

Since $\frac{v}{1-z} < 1$ and $F\left[\frac{vD+L+C^B+K^B}{D(1-z)} - 1\right] = 1$, the term in the braces is positive.

Equation (4.37h) implies that for a given level of deposits, the marginal cost of extending loans increases with the volume of loans as the bank becomes less liquid. If the incremental cost of borrowing is zero, i.e. b=0, then equation (4.37h) reduces to equation (4.47); loans will be made to the point where the marginal return to loans is equal to the bond rate. In the real world, it is unlikely that the borrowing premium will be zero. Traditionally, the central bank exerts its influence in the reserve market to

affect the loan rate. Other things being equal, a rise in the borrowing premium will lead to a rise in the loan rate.

In short, in the case of a non-binding liquidity constraint, banks are likely to shield their loan supply from an unanticipated shortfall of deposits by changing their bond holding position. For instance, unexpected inflows of deposits will be matched by an increase in the holdings of bonds in the short run, while unanticipated outflows of deposits will be matched by a decrease in the holding of bonds. Given the possibility that banks can and will alter their bond holding in response to deposit and reserve fluctuations, the existence of the lending channel does not require banks to be completely incapable of substituting bonds into loans; it merely requires banks to face the incremental cost of borrowing in the central bank's reserve market.

In addition, in the case of a non-binding constraint, the existence of a CD market (or any other specific deposit markets) should have no direct and immediate impact on bank lending activities as banks can adjust their bond holdings to offset any short-term fluctuation of deposit flows. However, once banks reach a binding liquidity constraint, the deposit markets, especially short-term wholesale deposit markets, for example, the CD market, will become crucial to bank lending activities.

4.5.b. Binding liquidity constraint

If the constraint is binding, then equation (4.45) holds as an equality and $\lambda > 0$. Equation (4.41) can be manipulated into

$$\lambda = r^L(1+\frac{1}{e_L})-r \tag{4.41*}$$

Condition equation (4.43) can be manipulated into

$$r - rz^C - r^C(1+\frac{1}{e_C}) + \lambda(1-z^C-v) = 0 \tag{4.43*}$$

Substituting equation (4.41*) into equation (4.43*), yields

$$r^L(1+\frac{1}{e_L})(1-z^C-v) + vr = r^C(1+\frac{1}{e_C}) \tag{4.49}$$

where e_C denotes the interest rate elasticity of demand for CD

Substituting equation (4.48) into equation (4.49), we have

$$r^L(1+\frac{1}{e_L}) = r^C(1+\frac{1}{e_C})\theta \tag{4.50}$$

where $\theta = \dfrac{1}{(1-z^C)}$

In equilibrium, the marginal cost of CD is set equal to its marginal return, and the loan rate is a markup over the CD rate. If the liquidity constraint becomes binding, banks have no excess bond holding, and their loan-making decision will depend on how easy and cheaply banks can replace lost (retail) deposits with other sources of funds. The existence of the lending channel does not require banks to be totally incapable of replacing lost deposits, it only requires that banks do not face a perfectly elastic demand for their managed liabilities. If the demand for bank managed liabilities were perfectly

elastic, then the effectiveness of the lending channel would depend on whether or not there is a reserve requirement on the managed liabilities.

By slightly manipulating equation (4.50), we have

$$r^L(1+\frac{1}{e_L}) = r^C\left[1+\frac{\partial r^C}{\partial CD}\frac{CD}{r^C}\right]\theta \qquad (4.51)$$

If $\frac{\partial r^C}{\partial CD}$ is very small, ceteris paribus, the loan rate will rise only slightly in response to the issuance of CD. As a consequence, a large volume of new CD issuance is expected to be issued. On the contrary, if $\frac{\partial r^C}{\partial CD}$ is large, the loan rate will rise significantly, and fewer new CD will be issued (Kashyap and Stein,1993).

Bernanke and Gertler (1995) contend that despite financial deregulation and innovation, it remains likely that the demand for bank managed liabilities is not perfectly elastic. This is because of, inter alia, lack of deposit insurance and liquidity. Many CD are non-negotiable or difficult to trade on secondary markets. As a result, new investors will only be induced to hold CD if they are paid higher interest rates[14].

In an extreme case in which the demand for managed liabilities is perfectly elastic with respect to the CD rate, i.e. $\frac{\partial CD}{\partial r^C} \to \infty$ or $\frac{1}{\frac{\partial CD}{\partial r^C}} \to 0$, equation (4.51) reduces to

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[14] In the context of our theoretical model in which the real wealth is assumed to be fixed, the demand for bank managed liabilities is unlikely to be perfectly elastic as there are portfolio restrictions; this will be discussed below.

$$\frac{\partial L^D}{\partial r^L} = \frac{L(r^L)}{\theta r^C - r^L} \tag{4.52}$$

In equation (4.52), if the demand for managed liabilities is perfectly elastic and there is no reserve requirement imposed on CD, that is, θ = 1, then $\frac{\partial L^D}{\partial r^L} = \frac{L(r^L)}{r^C - r^L}$. If loans and bank-issued "bonds"(i.e, reserve-free CD) are perfect substitutes, then $\frac{\partial L}{\partial r^L} \rightarrow -\infty$ as $r^C \rightarrow r^L$; the lending view's three-asset model collapses to the conventional money view's two-asset model.

Generally, a reserve requirement has two major impacts on banks' ability to provide intermediary services.

First, changes in reserve requirement restrain the banks' capacity to expand credit through a reserve multiplier defined as

$$\Delta L^S = \frac{1}{z} \Delta MB \tag{4.53}$$

where L^S = loan supply, z = reserve requirement ratio, MB = the monetary base [unborrowed reserves (RU) + borrowed reserves (RB)]

Second, by requiring banks to set aside part of their deposits as required reserves which earn low or no rate of return, changes in the reserve requirement ratio can influence the banks' ability to attract deposits. To see this effect, let us assume that both CD and DD earn interest, r^C and r^D respectively.

$$\Pi = r^L L(r^L) + r[DD + CD - z^D DD - z^C CD - C^B - K^B - L(r^L)] - r^D DD - r^C CD \tag{4.54}$$

Differentiating equation (4.54) with respect to r^C and r^D and then after some simple algebra, we have

$$r^D = \frac{r(1-z^D)}{(1+\frac{1}{e_D})} \qquad r^C = \frac{r(1-z^C)}{(1+\frac{1}{e_C})} \tag{4.55}$$

For given elasticities of demand for deposits, $r^D \leq r^C$ as $z^D \geq z^C$ and $r^D \geq r^C$ as $z^D \leq z^C$.

Two interesting things should be noted about bank liability management

First, if the demand for bank managed liabilities is perfectly elastic and no reserve requirement is imposed on the managed liabilities, then banks should be able to circumvent a reduction in bank reserves induced by open market operations by issuing CD. As a result, a reserve nexus between open market operations and the supply of loans is broken as banks can fully offset a decline in bank reserves. This scenario can refer to the dashed arrows in Figure 4.1. In equation (4.27), if the supply of loans is not influenced by the monetary shock, then $\frac{\partial L^S}{\partial m} = 0$ and in equation (4.31) $\frac{\partial r^L}{\partial m} = 0$. The lending channel is weak.

Nonetheless, the interest rate link between open market operations and the loan rate may still exist, even when the reserve link is severed. In the three-asset world where private and public bonds are assumed to be perfect substitutes, a rise in interest rates on the public bonds should permeate to interest rates on the private bonds. This interest rate link can refer to the dotted arrow in Figure 4.1 and equations (4.48) and (4.50).

In equations (4.48) and (4.50), it can be seen that the bond rate, the CD rate and the loan rate are related. By substituting equations (4.48) into (4.50), we obtain

$$r^L(1+\frac{1}{e_L}) = r = r^C\left[\frac{(1+\frac{1}{e_C})}{(1-z^C)}\right] \tag{4.50a}$$

In the lending view's three-asset model, government bonds and bank-issued "bonds" are assumed to be perfect substitutes, implying that e_C is equal to infinity from the point of view of bond and CD investors. That is,

$$r = \frac{r^C}{1-z^C} \tag{4.50b}$$

Bank loans and bonds are, on the other hand, considered imperfect substitutes, implying that e_L is not equal to infinity from the point of view of borrowers. Though bonds and CD are assumed to be perfect substitutes in the three-asset model, in reality they are not because of the reserve requirement ratio imposed on CD. Equation (4.50b) reiterates what is argued earlier that if the monetary policy instrument is traditional open market operations, which are conducive to changes in the bond rate, the lending channel is merely an enhancement mechanism to the conventional money channel.

Second, bank liability management is basically nothing more than a method of inducing the public to switch from more to less liquid bank liabilities. In the money supply equation (4.22), at a given level of reserves supplied by the central bank, liability management is simply a technique for enticing the public to change their currency

holding ratio (h). For example, if the non-bank public is tempted to hold less currency, a fall in h will, inter alia, lead to a rise in M, which can be offset by an increase in the reserve requirement ratio (z).

In the short run, it is plausible that with liability management banks may be able to maintain or perhaps even increase their lending capacity. In the long run, it is, however, questionable whether a reserve-generating process through liability management will necessarily create an adequate supply of reserves to meet banks' reserve demand. During the period of monetary tightening, the central bank's open market sales of government bonds means that the household sector should have already held more bonds (B^H) and less of the money stock (C^H + DD) in its portfolios.

At a given real net wealth of the household sector, which can be expressed as

$$W^H = C^H + \text{DD} + \text{CP} + \text{CD} + B^H - L^H$$

Open market sales of government bonds imply a decline in the household's money stock (C^H + DD) and a rise in bond holdings (B^H). Thus, banks attempting to induce the household sector to hold more of their "bonds" may find it difficult to squeeze any further funds from the already-squeezed household sector. Once the market cannot generate an adequate supply of funds, a liquidity shortage will then emerge. Banks will eventually have to reduce their loan supply.

In fact, apart from running down their excess bond holdings or issuing certificates of deposit, banks can also raise funds through loan securitization. Loan securitization is a process of pooling and re-packaging homogenous loans (for example, home mortgages) into securities and then selling to a group of investors, who purchase a financial

instrument evidencing the indebtedness without recourse to the original lender. This securitization generates funds for banks for further lending activities. In a broader sense, loan securitization or loan selling is analogous to excess bond selling because rather than selling excess bonds, banks instead sell loans outstanding in the form of collateral-backed securities (that is, "bonds" in the three-asset model).

In the simplified balance sheet (Table 4.1), loan securitization operations entail no change in overall total assets and liabilities. In the context of the lending view's three-asset model, loan securitization is merely a process of substituting loans for collateral-backed "bonds". If this substitution could be done easily and costlessly, then the existence and effectiveness of the lending channel would be in doubt.

4.6. The Lending Channel and the Money Channel in an Open Economy

Our model makes two major assumptions: a constant price level and a closed economy. A constant price level or, more realistically, an imperfect price adjustment is assumed essentially to prevent "monetary neutrality"[15]. The closed-economy assumption is made to exclude the exchange rate channel of monetary policy transmission. With the increasing globalization of the world financial market, it is almost impossible to completely ignore the exchange rate channel. Although the main thrust of our analysis is about the lending channel, in this section we will briefly analyze the exchange rate channel.

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15 According to Kashyap and Stein (1993), if prices adjust frictionlessly, a change in nominal bank reserves will be met with an equi-proportionate change in prices, and both bank and corporate balance

Like the conventional money channel, the exchange rate channel also involves interest rate effects. This is because when domestic real interest rates rise, domestic currency becomes relatively more attractive and entices capital flows causing the domestic currency to appreciate. The higher value of the domestic currency makes domestic goods more expensive, thereby causing a fall in net export and output.

Conceptionally, the exchange rate channel derives from what is known as the interest rate parity theorem which states that the differential in domestic and foreign interest rates is equal to the forward exchange rate premium or discount. The interest rate parity theorem is basically a statement about the law of one price, which asserts that securities or assets in all markets that share the same characteristics should yield the same rate of return (Rivera-Batiz, 1989):

$$r - r^* = f = \frac{(F - e)}{e} \qquad \text{(cover interest rate parity)}$$

where r = domestic interest rate, r^* = foreign interest rate, e = exchange rate, and f = forward premium or discount, and F= forward exchange rate

In an open economy, the effectiveness of monetary policy depends critically on the exchange rate regime. Under a flexible exchange rate, monetary policy is powerful as discussed above. On the contrary, under a fixed exchange rate, monetary policy is impotent due to what is known as an offsetting capital-flow effect.

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sheets will remain unaltered in real terms. In this case, there can be no real effects of monetary policy through either the lending channel or the conventional money channel.

The central bank's simplified balance sheet in an open economy

Assets: B^C + IR

Liabilities: C + BD

where IR = international reserves; C = currency; BD = bank deposits at the central bank; and B^C = government bonds held by the central bank

$$MB = H = C + BD = B^C + IR$$

where MB = monetary base, H = high-powered money

MB is related to the money supply through the money multiplier.

$$M1 = \mu MB$$

where μ = money multiplier

In an open economy under a fixed exchange rate system, two factors influence the monetary base: the central bank's actions and the balance of payments situation of the economy. Consider the case of the central bank's credit actions. For example, the central bank's open market sales of government bonds imply a fall in the central bank's government bond holdings and a fall in bank deposits at the central bank (i.e. a fall in bank reserves) and hence a decline in the monetary base. At a given money multiplier and price level, this leads to a decrease in the real money balance and a rise in interest rates. A rise in domestic interest rates will attract capital inflows. To maintain a fixed exchange rate, the central bank will be obliged to buy foreign currencies; thereby increasing its foreign reserves.

On the liability side of the central bank's balance sheet, open market sales of bonds mean a fall in bank reserves, while the central bank's purchases of foreign currencies mean a rise in domestic currency. In an extreme case where a fall in the monetary base was proportionately equal to a rise in the international reserves, the central bank would be unable to change the overall money supply, unless it was able to effectively sterilize the effect of capital flows.

In equation (4.36), under a pegged exchange rate, a conventional monetary policy in the form of traditional open market operations is ineffective, i.e. $dm = 0$. In this case, the central bank will have to rely more on direct credit actions, such as, credit ceilings, to bring down the loan supply. If banks were fully compliant with the central bank's credit ceilings, the effectiveness of monetary policy would depend on to what extent firms can obtain funds elsewhere.

In the real world, only a handful of firms with an exceptional reputation can borrow freely in foreign capital markets. Thus, the central bank's "binding" credit ceilings are likely to affect bank-dependent firms which are unable to obtain funds elsewhere, and also banks which experience high liquidity due to capital inflows, but are unable to lend due to the ceilings. In Thailand, financial liberalization and the establishment of the Bangkok International Banking Facility (BIBF) have made it easier for domestic borrowers to obtain external funds and hence weakened the effectiveness of monetary policy in general and credit controls in particular[16].

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[16] Theoretically, Thailand should not have an independent monetary policy, given that it was an open economy with a *de facto* fixed exchange rate regime (before July, 2, 1997). Practically, Thailand seems to have a considerable degree of monetary autonomy, thanks to several forms of capital controls imposed

In a broader sense, the central bank's credit ceiling behaves somewhat like exogenous credit rationing; that is, it is imposed exogenously from outside the banking system. In theory, there is also a possibility of endogenous credit rationing introduced by banks themselves. If banks do ration credit, how does the endogenous credit rationing affect the theoretical propositions and arguments discussed in the pervious sections? What are the implications of the existence of the endogenous credit rate in monetary policy transmission? Does the lending view critically depend on whether or not banks ration credit? The following section will attempt to find conceptual answers for these questions.

4.7. Monetary Policy Shocks in the Presence of Endogenous Credit Rationing

In the real world, some kind of credit rationing may initially exist before monetary policy is tightened. How important is credit rationing in monetary policy transmission? While the lending view forecasts a leftward shift in the loan supply and a rise in the loan rate after monetary tightening, credit rationing predict no changes in the loan supply and the loan rate. According to Jaffee and Modigliani (1969), there are two types of credit rationing: equilibrium rationing and dynamic rationing.

4.7.a. Equilibrium credit rationing

Equilibrium rationing results from heterogeneity in bank customers' risk classification. Stiglitz and Weiss (1981) argue that it may pay banks to operate below a Walrasian

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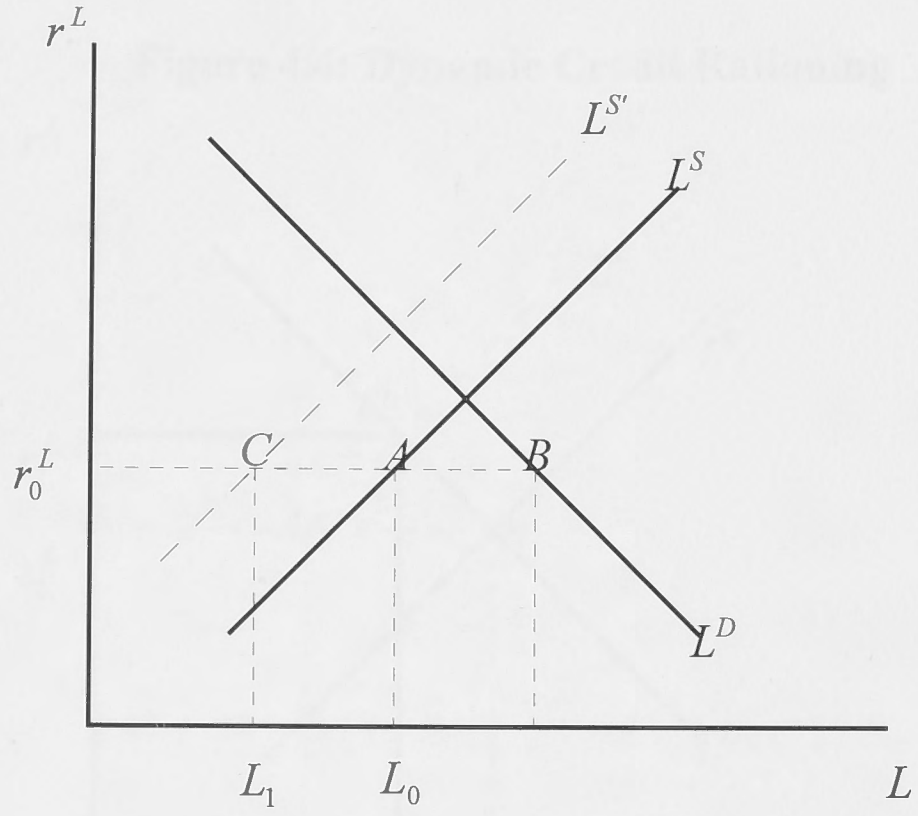
by the Bank of Thailand (Warr and Nidhiprabha, 1996). In the early 1990s, most of these capital controls were removed as part of financial liberalization, leaving the Bank of Thailand with less and less control over the domestic money supply.

equilibrium, even if in doing so excess demand for loan is created. The existence of excess demand generally may not induce banks to increase the interest rate: to do so might reduce their expected rate of return.

Stiglitz and Weiss (1981) provide two reasons for the possible inverse relationship between the rate of interest charged and the expected return to banks. First, at the higher interest rate, the proportion of high-risk borrowers is increased (the adverse selection effect). Second, at the higher interest rate, each borrower may be tempted to engage in riskier investment (the incentive or moral hazard effect). As a result, in equilibrium, a loan market may be characterized by credit rationing: banks are concerned about the interest rate they receive on loans and the riskiness of the loans.

As shown in Figure 4.3, assume that initially the volume of loans extended is L_0; a tight monetary policy would reduce the volume of loans even further to L_1, provided that C2 holds. Excess demand AB is a result of the credit rationing, while excess demand CA is a consequence of monetary tightening. If the excess demand (CA) cannot be satisfied by other sources of finance which are close substitutes to bank loans (i.e C1 holds), then monetary policy will have real effects. As a consequence, the presence of credit rationing merely intensifies the impact of the tight monetary policy.

Figure 4.3: Equilibrium Credit Rationing

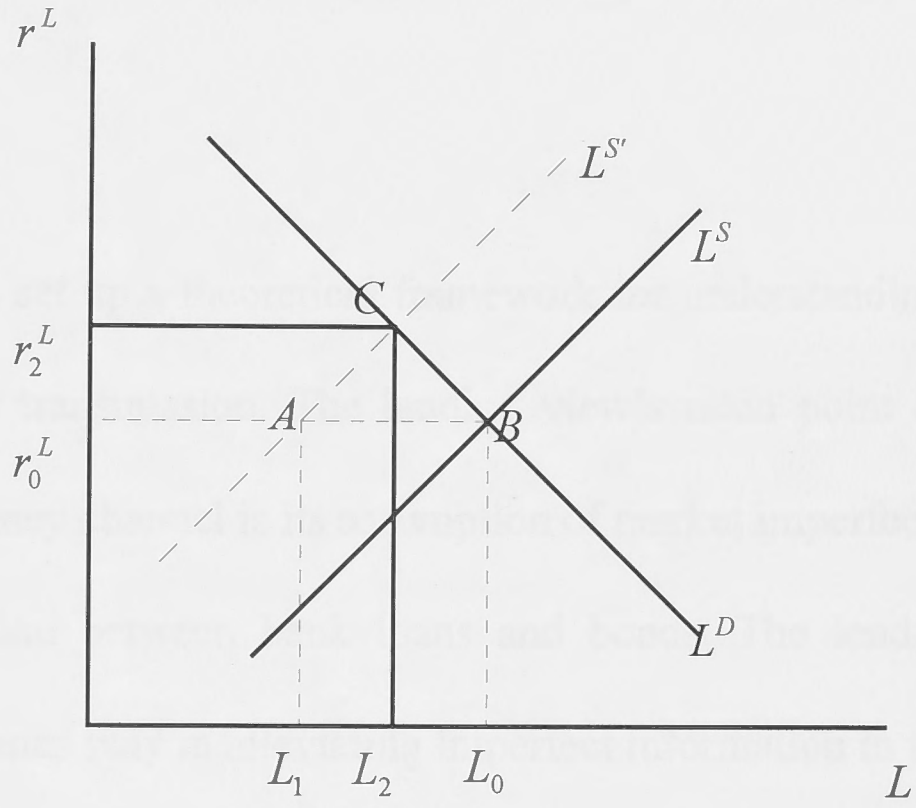


4.7.b. Dynamic credit rationing

Dynamic rationing is defined as the transitory difference in the quantity of excess demand for funds that arises from loan market imperfection which is reflected in the sluggish movement of interest rate to a new equilibrium after changes in monetary policy. Generally, the interest rate adjustment lag is considered an impediment to monetary policy transmission. However, if there was some significant degree of credit rationing, lending rate stickiness might turn out to be a blessing rather than a curse for the contractionary monetary transmission mechanism.

Let Figure 4.4 represent the market for bank loans, and suppose there is a monetary tightening which causes the loans supply to shift to the left. With the existence of an interest rate adjustment lag, a tight monetary policy will have two effects: the interest rate effect (AC) and the dynamic credit rationing effect (AB). In Figure 4.4, the interest rate adjustment lag means that excess demand for loans may persist for some time before the loan rate is adjusted enough to clear the market and the equilibrium is re-established at point C.

Figure 4.4: Dynamic Credit Rationing



As in the case of the equilibrium rationing, the real effect of dynamic credit rationing also depends on whether or not the lending view's two necessary conditions are met, In Figure 4.4, C2 must hold so that the loan supply curve will shift leftward. C1 must also hold so that the excess demand AB cannot be satisfied elsewhere. In short, the conditions for the existence and the effectiveness of the lending view are still required to hold with and without the credit rationing.

Therefore, suffice it to say that the presence of credit rationing should not change the nature of the lending view. A tight monetary policy would simply make the banks which may be initially rationing credit even more cautious above extending loans. By the same token, an expansive monetary policy would make loans more available to those initially facing credit rationing. As pointed out by Kashyap and Stein (1993, page 3), "..*it* (the *lending channel) does not hinge critically on whether or not there is quantity rationing in the loan market. As a matter of practical reality, shifts in bank*

loan supply may well be accompanied by variations in the degree of rationing, but this is not necessary for there to be a meaningful lending channel".

4.8. Conclusion

This chapter has set up a theoretical framework for understanding the lending view of monetary policy transmission. The lending view's main point of departure from the conventional money channel is its assumption of market imperfection and rejection of a perfect substitution between bank loans and bonds. The lending view stresses the important role banks play in alleviating imperfect information in the capital market, and calls for the recognition of the role of bank lending in monetary policy propagation. In the conventional money channel, bank loans are considered irrelevant to investment and spending decisions, because loans and bonds are implicitly assumed to be perfect substitutes.

Although there is a possibility that monetary policy can be transmitted through the lending channel, it appears that the lending channel may only play a supplementing role, rather than an independent role to the money channel if monetary policy is conducted through conventional open market operations. However, if the central bank is prepared to cause a "credit crunch" by bringing down the supply of loans more directly, say, through direct credit actions, then it is possible that the lending channel can operate independently. Except for direct credit actions which can be deemed as special cases, the existence and effectiveness of the lending channel depends crucially on how banks respond to monetary tightening.

If bank liquidity constraint is non-binding, banks are likely to offset a tight monetary policy by running down their excess bond holdings; the lending view does not really require that banks be completely unable to substitute excess bonds for loans, it only requires that banks face the incremental cost of borrowing in the central bank's reserve market. In the case of binding constraint, banks are likely to raise new funds through CD issues. The lending view does not require that banks be totally incapable of replacing lost deposits; it merely requires that banks do not face a perfectly elastic demand for their managed liabilities. If the demand for bank managed liabilities were perfectly elastic, the existence of the lending channel would rest on whether or not there is a reserve requirement on the managed liabilities.

The theoretical model developed in this chapter is primarily based on the closed-economy assumption which allows us to exclude the exchange rate channel and focus on analyzing the money and the lending channels. Section 4.6 briefly discussed the concept of the exchange rate channel. It is argued that in an open economy with a fixed exchange rate, monetary policy is ineffective. In such an economy, the central bank has to rely on direct credit actions, such as, credit ceilings, to bring down the loan supply.

In a broader sense, the central bank credit ceilings behave like exogenous credit rationing. In theory and reality, there is also a possibility of endogenous credit rationing introduced by banks themselves. In the literature, the lending channel has been perceived by some to be critically dependent on bank credit rationing. Section 4.7 tried to explain conceptually that the lending channel does not essentially hinge on whether or not there is a quantity rationing in the loan market.

Chapter Five

Econometric Technique and Model Specification

5.1. Introduction

Before proceeding to the empirical analysis of the lending view, it is useful to spell out the econometric tools to be used in the analysis. Though the relationship between financial and monetary variables and economic activity can be examined in a variety of ways, this study will use an econometric technique known as a vector autoregression (VAR). Introduced by Sims (1980), the VAR model is a useful tool for analyzing the inter-relationship or inter-dependence between time-series variables. Though it is a relatively new tool of macroeconometrics, the VAR has rapidly become quite popular as it provides a flexible and tractable framework for analyzing economic time series. The VAR model allows users to examine the dynamic characteristics of the model by stimulating the response of the variables to particular shocks. The VAR generates residuals or innovations which can be thought of as unexpected shocks to the variables in the model (Keating, 1990).

This chapter is organized into eight sections. Section 5.2 and 5.3 describe the two categories of the VAR model: UVAR and SVAR. Section 5.4 and 5.5 explain a test of causality (Granger causality test) and a test of stationarity (unit root test) respectively. Section 5.6 outlines the estimating procedure of the SVAR model. Section 5.7. illustrates the model specification and restrictions adopted in estimating the SVAR model. Section 5.8 concludes

5.2. Unrestricted VAR (UVAR) Model

In the UVAR, all the variables are allowed to interact linearly with their own and other current and past values. Historical data are used to determine the quantitative impact each variable has on its own future values and the future values of the other variables. However, since current and past values of each variable appear in every equation of the UVAR model, the number of coefficients to be estimated tend to be large compared to the number of observations on the variables. With so many coefficients available to explain and so few observations, the estimated coefficients are subject to over-fitting. A traditional solution to the over-fitting problem of large UVAR models has been to use "prior beliefs" to reduce the number of coefficients to be estimated (Todd, 1984).

Imposing "prior beliefs" on the VAR model is strongly criticized by Sims (1980), who considers identification restrictions as simply "incredible". Sims (1980) chooses to ignore any prior restriction as well as the endogenous and exogenous distinction. In his view, the role of economic theory in the VAR modeling is simply to select relevant observed data series (Spanos, 1987). However, critics of the UVAR model argue that the lack of theoretical structure could render the UVAR model inappropriate not only for explanation and test of theories but also for policy analysis. Most recent studies, including those recently conducted by Sims (1986, 1992), choose to impose some sort of restrictions on the VAR model.

5.3. Structural VAR (SVAR) Model

SVAR was introduced to deal with "organizing" instantaneous or contemporaneous relationships among relevant variables, normally left hidden in the variance/covariance

matrix of innovations in the UVAR model. The SVAR model basically attempts to find a "sensible" solution to the problem of how to deal with the contemporaneous correlation among time series variables under the study, by imposing a "proper" set of restrictions (Amisano and Giannini, 1997).

Since the inception of the VAR literature, many different approaches have been proposed to obtain more efficient estimates in the VAR model. However, the most popular ones are those proposed by Sims (1986) and Blanchard and Quah (1989). Blanchard and Quah (1989) propose a restriction on a nominal demand shock. Under this approach, exogenous shocks are dichotomized into two kinds of shock: a nominal demand shock and a real supply shock. Blanchard and Quah postulate that an aggregate demand shock does not have a long-run effect on real output (GNP); only an aggregate supply shock does.

Although acknowledging that Blanchard and Quah's restriction method is quite theoretically appealing, we will not adopt it in our study. The main reason for this is that as far as our theoretical model is concerned, we have made no distinction between a (temporary) nominal shock and a (permanent) real shock. The main objective of our study is to provide a theoretical framework for understanding the lending view and the distinction between the conventional money channel and the lending channel.

Our theoretical model was developed primarily from the modification of the conventional IS-LM model. In theory, we know that the IS-LM model only accounts for the demand side of the economy; the IS and the LM curves can be combined to

derive the aggregate demand curve. Based on this theoretical basis and our theoretical model, the money channel affecting the LM curve and the lending channel affecting the CC curve (the modified IS curve) only generate temporary nominal effects[1].

Given the nature and the main objective of our study, we have chosen to adopt Sims (1986)'s approach to obtain the exact identification. Sims' (1986) approach involves a constraint on the free parameter space by providing an interpretation of contemporaneous correlation among variables (i.e. imposing restrictions on contemporaneous coefficients). This interpretation is called a "structuralization" of the VAR model.

In the SVAR model, Sims' (1980) original non-orthogonal vector automoving average (VAM) representation is transformed into an orthogonalized VAM representation. Most forms of transformation are carried out via a Choleski decomposition of the variance and covariance matrix of the reduced form disturbances, which involves modeling contemporaneous relationships among the variables in a triangular recursive form.

In the SVAR analysis, two issues are generally of particular interest: what is the dynamic response of endogenous variables to exogenous shocks? and what is the relative importance of exogenous shocks to movements in endogenous variables?. The first question is answered by a structural VAR model and impulse response function. The second question is answered by variance decomposition (Watson, 1994).

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[1]Monetary policy regardless of its transmission channel has no long-run effect as its effect is essentially dependent on a short-run imperfect price adjustment to prevent monetary neutrality. For instance, if the price level adjusts frictionlessly, a change in nominal bank reserves will be met with an equi-proportionate change in the price level. Both bank and corporate balance sheets will remain unchanged

To illustrate the SVAR model, we follow Enders (1995), who provides a simple but very insightful explanation for the SVAR model. Consider a first-order bivariate SVAR system:

$$\begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix}\begin{bmatrix} y_t \\ z_t \end{bmatrix}=\begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix}+\begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix}\begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix}+\begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{zt} \end{bmatrix} \quad (5.1)$$

where y_t and z_t are assumed to be stationary time-series variables, and ε_{yt} and ε_{zt} are white noise disturbances

Since system (5.1) is not identified owing to the presence of a contemporaneous effect between y_t and z_t , it cannot be directly estimated. However, by transforming system (5.1) into reduced-form equations, it is possible to obtain consistent estimates of the parameters.

System (5.1) can be written in matrix form

$$Bx_t = \Gamma_0 + \Gamma_1 x_{t-1} + \varepsilon_t \quad (5.2)$$

where $B=\begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix}$, $x_t=\begin{bmatrix} y_t \\ z_t \end{bmatrix}$, $\Gamma_0=\begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix}$, $\Gamma_1=\begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix}$, $\varepsilon_t=\begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{zt} \end{bmatrix}$

Premultiplying system (5.1) by B^{-1}, we obtain

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix}=\frac{1}{(1-b_{12}b_{21})}\left\{\begin{bmatrix} b_{10}-b_{12}b_{20} \\ b_{20}-b_{10}b_{21} \end{bmatrix}+\begin{bmatrix} \gamma_{11}-b_{12}\gamma_{22} & \gamma_{12}-b_{12}\gamma_{22} \\ \gamma_{21}-b_{21}\gamma_{11} & \gamma_{22}-\gamma_{12}b_{21} \end{bmatrix}\begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix}+\begin{bmatrix} \varepsilon_{yt}-b_{12}\varepsilon_{zt} \\ \varepsilon_{zt}-b_{21}\varepsilon_{yt} \end{bmatrix}\right\}$$

(5.3)

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in real terms. In this case, there will be no real effect of monetary policy through either the lending channel or the conventional money channel (Kashyap and Stein, 1993: 8).

System (5.3) can be rewritten in an equivalent form:

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} \tag{5.4}$$

or in a more compact form

$$x_t = A_0 + A_1 x_{t-1} + e_t \tag{5.4a}$$

where $A_0 = B^{-1}\Gamma_0, A_1 = B^{-1}\Gamma_1, e_t = B^{-1}\varepsilon_t$

e_{1t} and e_{2t} are reduced-form innovations. Since they are composites of the two white noise disturbances in the structural VAR model, both e_{1t} and e_{2t} have zero means, and constant variance, and are individually serially uncorrelated.

Estimating system (5.4) by OLS yields consistent estimates of the reduced-form parameters. However, in a macroeconomic VAR analysis, it is the residuals, not estimated parameters, that are of more interest, as they can be used to study the dynamic response of the variables in the model to the exogenous shocks: the residuals can be thought of as unanticipated shocks.

5.3.a. Impulse response function

Converting system (5.4) into lag operator form, yields

$$\begin{bmatrix} 1-a_{11}L & -a_{12}L \\ -a_{21}L & 1-a_{22}L \end{bmatrix} \begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} \tag{5.5}$$

Premultiplying system (5.5) by $\begin{bmatrix} 1-a_{11}L & -a_{12}L \\ -a_{21}L & 1-a_{22}L \end{bmatrix}^{-1}$, we obtain

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \frac{1}{\Delta}\begin{bmatrix} 1-a_{22}L & a_{12}L \\ a_{21}L & 1-a_{11}L \end{bmatrix}\begin{bmatrix} a_{10} \\ a_{20} \end{bmatrix} + \frac{1}{\Delta}\begin{bmatrix} 1-a_{22}L & a_{12}L \\ a_{21}L & 1-a_{11}L \end{bmatrix}\begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} \qquad (5.6)$$

where $\Delta = (1-a_{11}L)(1-a_{22}L) - (a_{12}L)(a_{21}L) = 1-(a_{11}+a_{22})L + (a_{11}a_{22}-a_{12}a_{21})L^2$
$= (1-\lambda_1 L)(1-\lambda_2 L)$

where λ_1 and λ_2 are the roots of the equation

In order to have a convergent expansion for y_t and z_t in terms of e_{1t} and e_{2t}, it is required that the roots of the equation are less than one in absolute value, i.e. $|\lambda_1| < 1, |\lambda_2| < 1$. Once this stability condition is satisfied, y_t and z_t can be expressed as functions of the current and lag value of e_{1t} and e_{2t}.

System (5.6) can be rewritten as

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \bar{y} \\ \bar{z} \end{bmatrix} + \begin{bmatrix} \phi_{11}(L) & \phi_{12}(L) \\ \phi_{21}(L) & \phi_{22}(L) \end{bmatrix}\begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} \qquad (5.7)$$

where $\bar{y}, \bar{z}$ represent the two constant terms and ϕ_{ij} represent the four coefficients of the error terms.

In system (5.7), ϕ_{ij} are called *impulse response functions*: they show the current and lagged effects of changes in e_{1t} and e_{2t}, on y_t and z_t. System (5.7) is, thus, called *a structural moving average model*, since the elements of e_{it} can be interpreted as exogenous shocks to economic variables.

Unlike the structural VAR, the reduced-form VAR has no explicit structural economic interpretation. Therefore, if one is interested in analyzing the impacts of the structural shocks on the endogenous variables, it is essential to recover all information present in the primitive system (the structural VAR model) from the estimated system (the reduced-form VAR model).

However, since the primitive system is not identifiable, it is not possible to recover all the information from the estimated system straight away. In the estimated system, OLS yields nine parameters: $(a_{10}, a_{11}, a_{12}, a_{20}, a_{21}, a_{22})$ and the calculated values of var (e_{1t}) and var (e_{2t}) and cov (e_{1t}, e_{2t}), while in the primitive system there are 10 parameters: two intercepts, four autoregressive coefficients, two feedback coefficients, and two standard deviations $(b_{10}, b_{20}, b_{12}, b_{21}, \gamma_{11}, \gamma_{12}, \gamma_{21}, \gamma_{22}, \sigma_y^2, \sigma_z^2)$. Thus, unless one of the parameters in the primitive system is restricted, system (5.1) is under-identified.

For example, let b_{21}=0, system (5.1) becomes

$$\begin{bmatrix} 1 & b_{12} \\ 0 & 1 \end{bmatrix} \begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{zt} \end{bmatrix} \qquad (5.1^*)$$

and hence system (5.3) becomes

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} b_{10} - b_{12}b_{20} \\ b_{20} \end{bmatrix} + \begin{bmatrix} \gamma_{11} - b_{12}\gamma_{22} & \gamma_{12} - b_{12}\gamma_{22} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{yt} - b_{12}\varepsilon_{zt} \\ \varepsilon_{zt} \end{bmatrix} \qquad (5.3^*)$$

Estimating the system using OLS yields the theoretical parameter estimates:

$$y_t = a_{10} + a_{11}y_{t-1} + a_{12}z_{t-1} + e_{1t}$$
$$z_t = a_{20} + a_{21}y_{t-1} + a_{22}z_{t-1} + e_{2t}$$

where

(i) $a_{10} = b_{10} - b_{12}b_{20}$

(ii) $a_{11} = \gamma_{11} - b_{12}\gamma_{21}$

(iii) $a_{12} = \gamma_{12} - b_{12}\gamma_{22}$

(iv) $a_{20} = b_{20}$

(v) $a_{21} = \gamma_{21}$

(vi) $a_{22} = \gamma_{22}$

Since $e_{1t} = \varepsilon_{yt} - b_{12}\varepsilon_{zt}$ and $e_{2t} = \varepsilon_{zt}$, we can calculate the parameters of the variance/covariance matrix as

(vii) $Var(e_1) = \sigma_y^2 + b_{12}^2\sigma_z^2$

(viii) $Var(e_2) = \sigma_z^2$

(iv) $Cov(e_1, e_2) = -b_{12}\sigma_z^2$

There are now nine parameter estimates: $a_{10}, a_{11}, a_{12}, a_{20}, a_{21}, a_{22}$, $\text{var}(e_1)$, $\text{var}(e_2)$ and $\text{cov}(e_1, e_2)$ that can be substituted into the nine estimated equations above in order to simultaneously solve for $b_{10}, b_{20}, b_{12}, \gamma_{11}, \gamma_{12}, \gamma_{21}, \gamma_{22}, \sigma_y^2, \sigma_z^2$. However, the most sought-after estimates are $\{\varepsilon_{yt}\}$ and $\{\varepsilon_{zt}\}$ sequences which have to be recovered from the estimated system, using the fact that $e_{1t} = \varepsilon_{yt} - b_{12}\varepsilon_{zt}$ and $e_{2t} = \varepsilon_{zt}$. Decomposing the matrix of the residuals in this triangular fashion is called the Choleski decomposition.

In an n-variable VAR model, if the variance/covariance matrix of the structural disturbances is diagonal, then $n(n-1)$ restrictions are automatically imposed on the model, leaving only $\frac{n(n-1)}{2}$ additional necessary restrictions (Watson, 1994). For example, in the above two-variable model, one restriction must be made.

The Choleski decomposition is, however, criticized as being "atheoretical" (Keating, 1990). The above Choleski decomposition which restricts b_{21} to zero implies a recursive structure of the underlying structural residuals. Both ε_{yt} and ε_{zt} shocks are allowed to affect the contemporaneous value of y_t, but only ε_{zt} shocks affect the contemporaneous value of z_t. This implies that z_t is "prior" to y_t. This kind of ordering should have a theoretical foundation; otherwise the underlying shocks will be improperly identified.

Moreover, without a theoretical foundation, the ordering could be subjective and the order could affect the results significantly[2]. In the above discussion, setting $b_{21} = 0$ gives more weight to innovations in ε_{zt} shocks, since ε_{zt} shocks are allowed to have a contemporaneous effect on both y_t and z_t. In addition, the amplitude of the impulse response attributable to ε_{zt} shocks will be increased, as the ordering increases the magnitude of a "typical" shock in ε_{zt} and decreases the magnitude of a "typical" shock in ε_{yt} (Enders. 1995, page 327).

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[2] According to Enders (1995: 309), the importance of the ordering depends on the magnitude of the correlation coefficient between e_{1t} and e_{2t}. If the correlation is small, the ordering should not be of major concern.

The aim of the structural VAR model is to use economic theory, rather than a mere Choleski decomposition, to recover the structural innovations from the estimated reduced-form residuals. As pointed out by Watson (1994: 2903), "*the identifying restrictions must be dictated by the economic model under consideration. It makes little sense to discuss the restrictions without reference to a specific economic system*".

5.3.b. Variance decomposition

In the VAR analysis, another question of interest is the relative importance of exogenous shocks to the variability in the endogenous variables.

Following Enders (1995), consider unrestricted VAR (5.4a)

$$x_t = A_0 + A_1 x_{t-1} + e_t$$

where $x_t = \begin{bmatrix} y_t \\ z_t \end{bmatrix}$

Suppose we know the coefficients of A_0 and A_1, and wish to forecast the various values of x_{t+1} conditional on the observed value of x_t.

Updating system (5.4a) one period

$$x_{t+1} = A_0 + A_1 x_1 + e_{t+1} \tag{5.8}$$

and then taking the conditional expectation of x_{t+1}, i.e. $E(x_{t+1} / x_t)$, we have

$$E_t x_{t+1} = A_0 + A_1 x_1 \tag{5.9}$$

The one-period ahead forecast error is

$$x_{t+1} - Ex_{t+1} = e_{t+1} \tag{5.10}$$

For n-period ahead forecast

$$E_t x_{t+n} = (I + A_1 + A_1^2 + \ldots + A_1^{n-1})A_0 + A_1^n x_t \tag{5.11}$$

and the associated forecast error is

$$x_{t+n} - Ex_{t+n} = e_{t+n} + A_1 e_{t+n-1} + A_1^2 e_{t+n-2} + \ldots + A_1^{n-1} e_{t+1}$$

(5.12)

For illustration purposes, focus only on the $\{y_t\}$ sequence in the n-period ahead forecast error,

$$\begin{aligned} y_{t+n} - E_t y_{t+n} &= \phi_{11}(0)\varepsilon_{yt+n} + \phi_{11}(1)\varepsilon_{yt+n-1} + \ldots + \phi_{11}(n-1)\varepsilon_{yt+1} \\ &+ \phi_{12}(0)\varepsilon_{zt+n} + \phi_{12}(1)\varepsilon_{zt+n-1} + \ldots + \phi_{12}(n-1)\varepsilon_{zt+1} \end{aligned} \quad (5.13)$$

Let the variance of the n-period ahead forecast error variance of y_{t+n} be denoted by

$$\sigma_y(n)^2 = \sigma_y^2[\phi_{11}(0)^2 + \phi_{11}(1)^2 + \ldots + \phi_{11}(n-1)^2] + \sigma_z^2[\phi_{12}(0)^2 + \phi_{12}(1)^2 + \ldots + \phi_{12}(n-1)^2]$$

(5.14)

The forecast error variance decomposition (5.14) imparts the proportion of the movements in the $\{y_t\}$ sequence due to its "own" shocks, ε_{yt}, versus shocks to the other variable, ε_{zt}. For instance, if ε_{zt} shocks explain none of the forecast error variance of $\{y_t\}$ at all forecast horizons, the $\{y_t\}$ sequence is said to be exogenous. In such a circumstance, the $\{y_t\}$ sequence would evolve independently of the ε_{zt} shocks and the $\{z_t\}$ sequence.

On the other hand, if ε_{zt} shocks could explain all the forecast error variance in the $\{y_t\}$ sequence at all forecast horizons, then the $\{y_t\}$ sequence is said to be entirely endogenous. It should be noted that the variance decomposition has the same identification problem as in the impulse response function analysis. Thus, in order to

identify $\{\varepsilon_{yt}\}$ and $\{\varepsilon_{zt}\}$ sequences, it is necessary to impose some restrictions on the VAR model.

5.4. Granger Causality Test

One important feature of the SVAR model, (5.1), is that it allows for univariate time-series characteristics of each element of y_t and z_t and also for serial cross correlation between different elements of y_t and z_t. This means that the model allows for a link from, say, y_{t-1} to y_t, and from z_{t-1} to y_t as well as from y_{t-1} to y_t. Because the VAR model allows for such a variety of dynamic cross linkages, it is a useful vehicle for looking at "causality". A test of causality revolves around whether the lags of one variable significantly enter into the equation for another variable.

Reconsider system (5.4)

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix}$$

In system (5.4), it is possible to test the hypothesis that $a_{12} = 0$ using a *t*-test. In a two-equation model with one lag, $\{z_t\}$ is said to Granger-cause $\{y_t\}$, if $a_{12} \neq 0$. That is, $\{z_t\}$ is said to Granger-cause $\{y_t\}$, if the past value of $\{z_t\}$ can be used to obtain a forecast of future value of $\{y_t\}$ that is more accurate than using the past value of $\{y_t\}$ alone. In the *n* variable case in which $A_{ij}(L)$ represents the coefficients of lagged values of variable *j* on variable *i*, variable *j* does not Granger-cause variable *i* if all coefficients of the polynomial $A_{ij}(L)$ can be set equal to zero.

In the VAR model, Granger non-causality test is called a block exogeneity test as it is used to detect whether or not a variable Granger-cause other variables included in the VAR system, or in other words, testing whether a variable should be included in the model (Enders, 1995, page 316). For example, in the VAR model with four variables, say, y_t, z_t, w_t, x_t, the block exogeneity test involves testing whether lags of, say, w_t Granger-cause the other three variables. In essence, the block exogeneity test restricts all lags of w_t in y_t z_t, and x_t equations to be equal to zero. This cross restriction can be properly tested by a likelihood ratio (LR) test.

The likelihood ratio statistic is given by

$$T(\log|\Sigma_r| - \log|\Sigma_u|)$$

where T = number of usable observations

$\log|\Sigma_r|$ = the natural logarithm of the determinant of the variance/covariance matrix of the restricted residuals, Σ_r, that is. residuals from the equations in which all lags of w_t are restricted to zero.

$\log|\Sigma_u|$ = the natural logarithm of the determinant of the variance/covariance matrix of the unrestricted residuals, Σ_u

This LR statistic has an asymptotic chi-squared distribution with the degree of freedom equal to the number of restrictions in the system.

In the above illustration of the SVAR model, y_t and z_t are assumed stationary. This assumption is crucial because the validity of most time series econometric techniques depends on the assumption of stationarity. A stationarity time series is one created by a data generating process which ensures that mean, variance and temporal autocorrelations of the time series are constant over time. Since most macroeconomic time series are typically non-stationary, particularly nominal variables, there is a need for checking the stationarity. In macroeconomic analysis, if there is a shock involved in the model, whether the effects of the shock will die away, or become permanent, depends crucially on whether or not there is unit root.

5.5. Unit Root Tests

Unit root tests are a useful means for determining stationarity of time-series variables. Following Maddala (1992), consider a zero mean first-order autoregressive model

$$y_t = \rho y_{t-1} + \varepsilon_t \tag{5.15}$$

If ρ=1 and suppose there is a jump C in ε_t, then $y_t y_{t+1}, y_{t+2}, \ldots$ all increase by C. The effect of the shock will, thus, become permanent. But if $|\rho|<1$, then the effect of the shock will fade away over time. Thus, a time series with a unit root has a stochastic trend as each new innovation has a permanent effect on the level of the series.

A unit root testing procedure is to regress y_t on y_{t-1} to obtain, an estimated ρ, $\hat{\rho}$, and then calculate *t*-ratio: $\frac{\hat{\rho}-1}{SE(\hat{\rho})}$. This *t*-ratio has to be compared with the Dickey and Fuller tabulated critical value rather than the conventional t-ratio because the distribution of

the least squares estimate of the autoregressive parameter ρ has a non-standard distribution when there is a unit root.

Although y_t is nonstationary, its first difference, Δy_t may be stationary, assuming that ε_t is white noise.

$$y_t - y_{t-1} = \beta y_{t-1} + \varepsilon_t \tag{5.16}$$

where $\beta = (\rho - 1)$

Equation(5.16) is the basis for a standard form of AD test and the null hypothesis is that ρ = 1 or β=0. If the null hypothesis is not rejected, it would indicate that y_t is integrated to order one, or I(1), which means that one must take the first difference to get stationary Δy_t. Equation (5.16) is based on the assumption that ε_t is white noise. If ε_t is not white, for example, $E(\varepsilon_t \varepsilon_s) \neq 0$, i.e. there exists serial correlation, the augmented Dickey-Fuller (ADF) test is appropriate.

The standard form of the ADF test is

$$\Delta y_t = \beta y_{t-1} + \sum_{i-1}^{k} \theta_i \Delta y_{t-i} + \varepsilon_t \tag{5.17}$$

or if constant and trend are included

$$\Delta y_t = \alpha + \delta t + \beta y_{t-1} + \sum_{j=1}^{k} \theta_i \Delta y_{t-j} + \varepsilon_t \tag{5.18}$$

Generally speaking, a univariate time series y_t is said to be integrated of order d [denoted by I(d)], if it has a stationary, invertible, non-deterministic ARMA representation after differencing d times. Using this definition, one can classify a

stationary time series as being an I(0) process and a non-stationary time series as I(1) process, if it becomes stationary after first differencing.

After having some insight into the VAR model and related econometric techniques, we can now outline the estimating procedure of the VAR analysis.

5.6. The Estimating Procedure of the SVAR Model

As suggested by Pagan (1987), the estimating procedure of the SVAR model generally involves four steps:

5.6.a. Transform relevant variables into a form which fits into the VAR analysis

This first step involves a transformation of the variables so that each variable is stationary. This transformation is necessary as the statistical theory requires all relevant variables to be stationary; otherwise the effect of shocks will not dampen out (see Section 5.3(a)). This step typically involves conducting unit root tests and if variables are found to be non-stationary, taking first or higher order differences of each variable to achieve stationarity, as explained above.

5.6.b. Choose an appropriate lag length and dimension of the VAR model

In principle, it is possible to include many variables and lags in the VAR model. However, degrees of freedom are quickly eroded as more variables and lags are included. Economic theory has a role in choosing the dimension and specific element of the vector of variables (Pagan, 1987). If the dimension is small, a large number of lags may be required to proxy omitted variables (Darnell, 1994). However, one has to tread

carefully in selecting the lag length (or the order of the VAR model). If the lag number is too large, degrees of freedom are wasted. On the other hand, if the lag number is too small, the model may be misspecified.

Two selection criteria are usually used to determine the appropriate lag length: the Akaike information criterion (AIC) and the Schwarz Bayesian criterion (SBC). Basically, these criteria for selecting the order of the VAR(p), where p represents the maximum order selected by the user, involve choosing the VAR model with the highest value of AIC and SBC (Pesaran and Pesaran, 1997). In practice, SBC tends to suggest the selection of a lower order VAR than AIC.

5.6.c. Try to simplify the VAR by imposing some restrictions on the coefficient matrix.

As discussed in Section 5.3, imposing restrictions has been the subject of much criticism since the inception of the VAR literature. To ascribe any meaning to impulse response for the orthogonal innovations, it is necessary that the innovations be treated as structural shocks, and that requires the imposition of prior restrictions on the causal structure of the system, sometimes known as a Wold causal representation (Pagan, 1987) (Darnell, 1994).

Under Choleski decomposition, the ordering of the equations is critically important in determining the importance of innovations and can be arbitrary, which can make the interpretation of the orthogonal innovations ambiguous and a source of criticism. That is why economic theory usually has to be called upon to provide a theoretical

justification for the imposition of restrictions, and this will be discussed in the following section

5.6.d. Use the orthogonalized innovation representation to address the question of interest

In the macroeconomic VAR analysis, two questions are generally of particular interest: what is the dynamic response of endogenous variables to exogenous shocks? and what is the relative importance of exogenous shocks to movements in endogenous variables?. These two questions are the main focuses of this study.

Steps I, II, and IV are rather straightforward, whereas step III needs further elaboration as it is a contentious issue in the SVAR model. The following section will explain the model specification and restrictions used in this study.

5.7. Model Specification and Restriction

5.7.a. Model specification

Generally, studies on the links between the real economy and monetary policy centre on two key issues. First, by what mechanism(s) do changes in monetary policy affect the real economy? That is a transmission question. Second, among various monetary and financial variables, which are the best or the most useful predictors of future economy activity? That is a forecasting question. As far as the first question is concerned, it is generally agreed that monetary tightening through an open market sale will have an impact on both liabilities (deposits) and assets (loans and securities) of the banking system.

The ability of the central bank to affect the scale of bank balance sheets is not controversial and is widely accepted as part of both the money and the lending channels (Bernanke, 1993). However, what appears to be controversial is how a reduction in bank assets and liabilities goes on to affect the economy. In the conventional money view, the critical effect comes from a reduction in bank liabilities (deposits), as a shortage of the transaction medium increases interest rates, which, in turn, discourages spending through a cost-of-capital effect. On the contrary, in the lending view, a fall in bank assets (securities and loans) is considered potentially important in the transmission of the monetary policy.

A loss of reserves (securities) caused by monetary tightening will over time induce banks to cut back their loan supply, provided that reserve requirement is binding on the behaviour of banks[3]. Given that there are borrowers who do not have access to alternative sources of financing apart from bank loans, a decline in bank lending will slow down the aggregate demand side of the economy, and for some economists (for example, Blinder,1989) possibly aggregate supply of the economy as well[4].

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[3] As analyzed in Chapter Four, if reserve losses failed to constrain the behaviour of banks, then both the money channel and the lending channel would be in serious doubt. The money channel could be weakened if there were assets that are close money substitutes, but subject to low or no reserve requirement. The lending channel could be attenuated if banks managed to raise loanable funds without being subject to reserve requirement.

[4]Alan Blinder (1989) developed a theoretical model which could explain a possible effect of monetary policy through the supply side of the economy. Since the main aim of the model developed in this thesis is to see how the lending view can be distinguished from the conventional money view, an in-depth analysis of the supply-side effect is beyond the scope of this thesis.

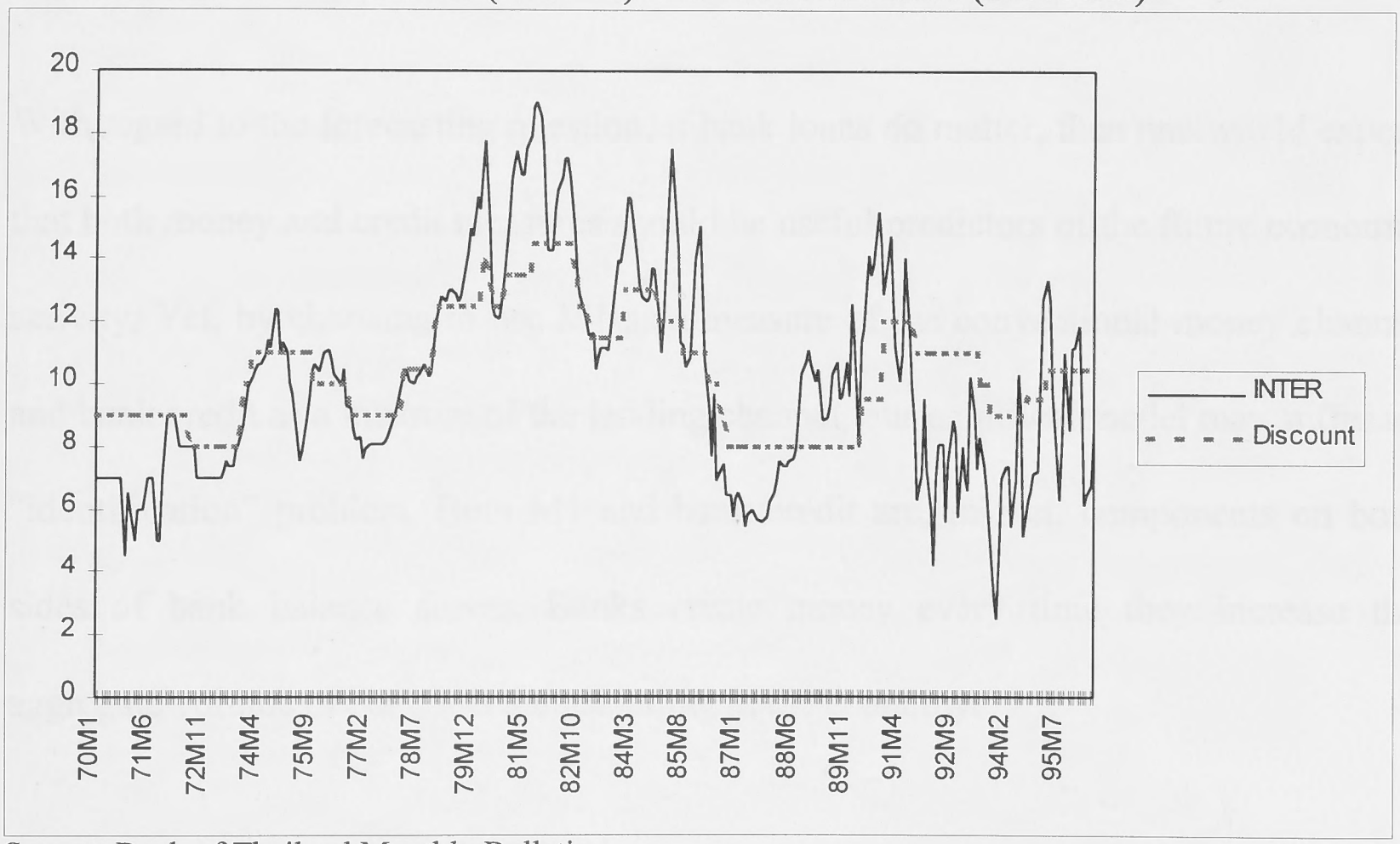
To examine a monetary policy transmission through the lending channel, the first thing one has to do is to find out which variable(s) can be used as a proxy for monetary policy stance. In this study, we opt to use the inter-bank rate as an indicator of monetary policy. In most studies on the lending view, for example (Bernanke and Blinder, 1990), (Gerlter and Gilchirst, 1992), (Kashyap, Stein, and Wilcox, 1993), (Oliner and Rudebusch, 1993), and others, the inter-bank rate was used as the indicator.

Strictly speaking, the interest rate used in these studies is really not the inter-bank rate, but the Federal Funds rate. As pointed out by Perry and Klein (1988), the Federal Funds rate is quite a misnomer in the sense that it has nothing to do (directly) with the US Federal Reserves Bank. Federal Funds traditionally refer to the reserves of the member banks of the US Federal Reserve system, which are traded between these banks at the Federal Funds rate.

In Thailand's banking system, the inter-bank rate can be considered as an equivalent of the Federal Funds rate. Traditionally, Thai commercial banks obtain reserves from three major sources: the inter-bank market, the repurchase market, and the discount window facility. The latter two are directly controlled by the Bank of Thailand. Although the Bank of Thailand has no direct control over the inter-bank market, it can, by acting as lender of last resort, significantly influence the market. For example, by reducing the amount of reserves to the banking system, the Central Bank can drive up the inter-bank rate, a major cost of acquiring reserves.

The inter-bank rate is by no means the only potential indicator of monetary policy; there are other potential candidates, such as, the discount rate and the repurchase rate. Despite being a relatively minor source of reserves for the commercial banks (see Table 2.5 in Chapter Two), a change in the discount rate is normally considered by the market as a signal of a change in the central bank's monetary policy stance. However, to be used as the monetary policy indicator in the empirical model, the discount rate has one major shortcoming, which is that it is rarely changed.

Table 5.1: Inter-Bank Rate (INTER) and Discount Rate (Discount)



Source: Bank of Thailand Monthly Bulletin

In addition, for the banks, access to the discount window facility is considered a privilege, not a right. They have to comply with rules and regulations imposed by the Bank of Thailand making borrowing from the discount window relatively difficult and normally inaccessible. Even though the discount window facility is not the source of funds the commercial banks usually resort to, a change in the discount rate generally reflects the Central Bank's monetary policy stance. In Figure 5.1, it can be seen that the inter-bank rate does appear to move in tandem with the discount rate.

The repurchase rate is also another potential candidate for the indicator. Nonetheless, as explained in Chapter Two under the current system used in the repurchase market, the Bank of Thailand's ability to influence the liquidity in the banking system through the repurchase market is limited. Given the shortcomings of the discount and the repurchase rates, we opt to use the inter-bank rate as the policy indicator. Monetary tightening (a positive innovation in the inter-bank rate) is expected to result in a fall in the holding of securities and the supply of loans (banks' assets), and a contraction in the volume of deposits (banks' liabilities).

With regard to the forecasting question, if bank loans do matter, then one would expect that both money and credit measures should be useful predictors of the future economic activity. Yet, by choosing to use M1 as a measure of the conventional money channel and bank credit as a measure of the lending channel, our empirical model may suffer an "identification" problem. Both M1 and bank credit are, in fact, components on both sides of bank balance sheets. Banks create money every time they increase the aggregate volume of bank loans outstanding in the economy.

In addition, it is quite difficult to identify the existence of the lending channel merely through a co-movement between bank credit and output. Kashyap, Stein, and Wilcox (hereafter KSW)(1993) argue that a decline in output may, in fact, be attributable to the conventional money channel. The fall in the quantity of loans may simply reflect a decline in loan demand due to reduced output (through the conventional money channel), not a reduction in loan supply.

KSW suggest that one way to avoid this type of identification problem is to focus on bank customers' substitution between bank loans and commercial paper (which are taken as a representative of non-bank finance). KSW propose two measures to test the existence of the bank credit channel. One is the mix of external finance used as an indicator of restrictions on a bank's ability to lend. The mix measure is defined as the ratio of bank loans outstanding to the sum of bank loans and commercial paper outstanding. The other measure is the spread between the prime rate charged by banks on short-term loans and the rate on six-month commercial paper.

The intuition behind these tests is that suppose monetary policy operated solely through the money channel, and that there was a fall in bank loans after monetary tightening, which was due merely to an output-induced effect on credit demand. One would expect that the demand for non-bank finance and hence the volume of commercial paper should also fall as well. However, if the central bank's tightening primarily reduced the supply of bank loans, one would expect to see an increase in commercial paper issuance. Similarly, if firms could only borrow from banks, then one would expect to see a rise in the interest rate spread when bank lending was restricted more than other types of lending.

The KSW approach is, nonetheless, not without its critics. Romer and Romer (1993) argue that the mix and spread may not be good indicators of banks' ability to lend. Firms that depend on banks for financing are generally riskier than firms that can borrow in the open markets. Thus, bank loans may fall relative to commercial paper in response to a tight monetary policy not because banks have difficulty in obtaining

funds, but because lenders do not wish to lend to relatively risky firms at the time when interest rates are high and the economy is weakening.

In spite of having some shortcomings, the KSW approach does have some appeal. If data on Thailand's commercial paper were readily available, we would contemplate applying the KSW approach to Thailand. Given the data that are currently available, however, our empirical model will focus on testing two key issues: how monetary policy can be transmitted through the lending channel, and how changes in monetary policy, affecting the loan supply, affect the real economy.

The empirical analysis will, thus, involve estimating two SVAR models. Though it is possible to investigate the two issues in one single model, we believe that it is more appropriate to have two separate models. One specifically deals with the financial sector and a test of the transmission process (hereafter Model A). The other deals with the real economy sector and a test of the forecasting power of the monetary and financial variables (hereafter Model B). In addition, since the Choleski decomposition, which is sometimes criticized as being "atheoretical", is to be used to obtain an exact identification, it is necessary to provide some theoretical justification for the restrictions in the SVAR model. By having two separate models, it will be easier to apply a more logical theoretical justification for the restrictions.

As mentioned in Section 5.3, the identifying restrictions must be dictated by the economic model under consideration. The aim of the SVAR is to use economic theory, rather than a mere Choleski decomposition to recover the structural innovations from

the estimated reduced-form residuals. Therefore, the theoretical justification is needed, even though all restrictions are automatically set according to the ordering of the variables in the estimating process.

5.7.b. Model restriction and justification

5.7.b.i. Testing the transmission of monetary policy through the lending channel (Model A)

Four variables are included in this model: the inter-bank rate, bank reserves, demand deposits, and bank credit. With four variables, six restrictions are needed to obtain an exact identification, assuming that the variance/ covariance matrix of the structural disturbances is diagonal.

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ b_{21} & 1 & 0 & 0 \\ b_{31} & b_{32} & 1 & 0 \\ b_{41} & b_{42} & b_{43} & 1 \end{bmatrix} \begin{bmatrix} INTER_t \\ TR_t \\ DD_t \\ BC_t \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{20} \\ b_{30} \\ b_{40} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} & \gamma_{14} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} & \gamma_{34} \\ \gamma_{41} & \gamma_{42} & \gamma_{43} & \gamma_{44} \end{bmatrix} \begin{bmatrix} INTER_{t-1} \\ TR_{t-1} \\ DD_{t-1} \\ BC_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{INTER_t} \\ \varepsilon_{TR_t} \\ \varepsilon_{DD_t} \\ \varepsilon_{BC_t} \end{bmatrix} \tag{A}$$

or in a more compact form with p lags

$$Bx_t = \Gamma_0 + \Gamma \sum_{i=1}^{p} x_{t-i} + \varepsilon_t$$

where $x = \{INTER_t, TR_t, DD_t, BC_t\}$ is a vector, the elements of which denote the inter-bank rate, bank reserves, demand deposits, and credit, respectively.

(A) implies the following six restrictions.

I. The contemporaneous value of BC does not enter the inter-bank rate equation.

II. The contemporaneous value of DD does not enter the inter-bank rate equation.

III. The contemporaneous value of TR does not enter the inter-bank rate equation.

IV. The contemporaneous value of BC does not enter the reserve equation.

V. The contemporaneous value of DD does not enter the reserve equation.

VI. The contemporaneous value of BC does not enter the deposit equation.

The conceptual rationalization of the above six restrictions is that a policy-driven rise in the inter-bank rate forces banks to squeeze their reserves in the short-run. Monetary tightening should lead to a fall in deposits in the banking system and eventually a fall in the loan supply. Loans are unlikely to fall dramatically in the short run due to their quasi-contractual nature (a large proportion of loans are extended on a pre-arranged credit line, for example, overdraft loans).

In the theoretical model, it is contended that banks are likely to react to a tight monetary policy by reducing excess reserves. But once excess reserves are exhausted (or nearly exhausted), banks may be tempted to replenish their declining reserves through issuing short-term monetary instruments (e.g. certificates of deposit). Given the semi-contractual nature of bank loans and the existence of bank liability management, the fall in the loan supply after monetary tightening may not be imminent. But if monetary tightening persists, liquidity in the whole banking system will gradually reduce and the supply of loans will eventually fall.

Ideally, we wish to replace demand deposits (DD) with CDs to see the effect of bank liability management. But we are unable to obtain the data on CDs in Thailand. CDs were just introduced into Thailand's financial market in the early 1990s and have so far accounted for just about 1-2% of total deposits. Moreover, no monthly or quarterly data

on CDs have been officially published. Annual data were only published once in the Bank of Thailand's (1995) annual report (see Table 2.4 in Chapter Two).

5.7.b.ii. Testing the forecasting power of money and credit shocks (Model B)

This model, like the previous one, has four variables: money measure, credit measure, output measure, and price measure. Therefore, six restrictions are needed to be introduced into the model.

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ b_{21} & 1 & 0 & 0 \\ b_{31} & b_{32} & 1 & 0 \\ b_{41} & b_{42} & b_{43} & 1 \end{bmatrix} \begin{bmatrix} BC_t \\ M1_t \\ Y_t \\ P_t \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{20} \\ b_{30} \\ b_{40} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} & \gamma_{14} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} & \gamma_{34} \\ \gamma_{41} & \gamma_{42} & \gamma_{43} & \gamma_{44} \end{bmatrix} \begin{bmatrix} BC_{t-i} \\ M1_{t-i} \\ Y_{t-i} \\ P_{t-i} \end{bmatrix} + \begin{bmatrix} \varepsilon_{BC_t} \\ \varepsilon_{M1_t} \\ \varepsilon_{Y_t} \\ \varepsilon_{P_t} \end{bmatrix} \qquad \text{(B)}$$

where x=$\{ BC_t, M1_t, Y_t, P_t \}$ is a vector, the elements of which denote credit measure, money measure, output index, and price index, respectively.

(B) implies the following six restrictions

I. The contemporaneous value of *M1* does not enter the credit equation

II. The contemporaneous value of *P* does not enter the money equation

III. The contemporaneous value of *Y* does not enter the money equation

IV. The contemporaneous value of *P* does not enter the credit equation

V. The contemporaneous value of *Y* does not enter the credit equation

VI. The contemporaneous value of *P* does not enter the output equation

Restriction I implies that, ceteris paribus, a tightening of bank credit expansion caused by a tightening of the Central Bank's reserves supply should lead to a contraction in the deposit expansion of the banking system and hence the expansion of the monetary aggregate (*M1*). As will be shown in the following chapter, there would be little effect on the SVAR results, if the ordering of *M1* and *BC* were swapped: the correlation

coefficient between *M1* and *BC* residuals is so low that the orthogonalization should have little effect.

Restrictions II-V imply that *P* and *y* shocks have no direct effects on *M1* and *BC*, but there are indirect effects of *Y* and *P* on the contemporaneous values of *M1* and *BC*. This asymmetric decomposition implies an ordering of the variables, i.e. *M1* and *BC* are implicitly assumed to be "prior" to *P* and *Y*[5]. It is important to note that *M1* denotes a nominal monetary aggregate. Theoretically, for monetary policy to have a real effect, it must be assumed that in the short run, say, a month, a price adjustment is less than perfect, so that an increase in a nominal money supply results in a rise in real money balances. It can also be assumed that individuals take the aggregate price level as given and choose to adjust their short-run level of nominal money balances. In this case, it is nominal, not real money balances, that matter (Wells, 1995).

Restriction VI is similar to one of the restrictions imposed in Sims (1986). It implies that *Y* will not adjust to changes in *P* within a month, while *P* is assumed to immediately respond to changes in *Y*.

All the restrictions imposed in both models fit into the Choleski decomposition, i.e. all elements above the principle diagonal are zero. This triangular decomposition implies a recursive structure of the underlying structural residuals, i.e, the matrix of estimated innovations is equal to the lower triangular matrix of structural disturbances. This recursive structure, sometimes known as a Wold causal chain, demands that the current

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[5] Note that in the unrestricted VAR, no variables are assigned to be exogenous: every variable is allowed to influence every other variables with a distributed lag of reasonable length, but in the structural VAR, a Choleski decomposition implies that certain variables are implicitly assigned to be exogenous (Clement and Mizon, 1991).

values of *BC* in Model A and *P* in Model B are determined by current values of all the other three variables in each model, and there is no feedback.

The persuasiveness of this no-feedback assumption depends essentially on the frequency of observations. The greater is the frequency of observations the more persuasive is the assumption (Darnell, 1994). For instance, if daily data are available on all variables, then it may be quite reasonable to impose a one-way causal chain, but if the data are monthly, then the uni-causal chain may not be quite appropriate. Since monthly data are used in this study, a bi-causal relationship among variables cannot entirely be ruled out.

5.8. Conclusion

This chapter spells out econometric techniques to be used in the empirical analysis. The main econometric tool is the structural VAR (SVAR). The beauty of SVAR is its relatively flexible framework for analyzing the inter-relationship or inter-dependence between time-series variables. The impulse response function and variance decomposition are of particular interest in the empirical analysis. The former is used to analyze the dynamic response of endogenous variables to exogenous shocks. The latter is employed to study the relative importance of the exogenous shocks to the variability in the endogenous variables. Two empirical models are set to be investigated in the following chapters. One focuses on testing the transmission of monetary policy through the lending channel and the other on testing the forecasting power of money and credit shocks.

Chapter Six

Empirical Analysis of Monetary Policy Transmission through the Lending Channel

6.1. Introduction

The objective of this chapter is to undertake an empirical analysis of the lending channel. The empirical analysis will centre on two key empirical tests: testing the transmission of monetary policy through the lending channel (Model A) and testing the forecasting power of money and credit shocks (Model B). This chapter consist of four sections. Section 6.2 provides data description. Section 6.3 undertakes empirical estimation. Section 6.4 presents estimation results and interpretations. Unit root tests, variance decomposition, and impulse response function are among the results presented. Section 6.5 analyzes a narrative approach used to analyze the effect of monetary shocks. Section 6.6 concludes.

6.2 Data Description

Data employed in this study are monthly seasonally adjusted data from January 1970 to June 1996. The data are for seven variables: bank credit to the private sector (BC), money supply (M1), the inter-bank interest rate (INTER), bank reserves (TR), demand deposits (DD), the industrial price index (P), the industrial output index (Y). Details concerning definitions and sources of the data are provided in Appendix III.

The industrial price index (P) is the Laspeyres index computed by the following formula:

$$P_t^{La} = \frac{\sum_{i=1}^{5} P_{it} Q_{i0}}{\sum_{i=1}^{5} P_{i0} Q_{i0}}$$

where P_{it} are the price indexes of five industrial outputs: beverages (beer and soft drink); petroleum products; automobiles (cars, transportation vehicles, and motorcycles); textiles (jute products and synthetic fiber); and construction materials (cement, white cement, and iron sheet).

These five industrial outputs are chosen as they are the only ones that have been consistently and continuously available since 1970. P_{it} are adjusted to account for the changes in the base year. Since 1970, the base year has been changed three times; from January 1970 to December 1979, the base year was 1968; from January 1980 to December 1990, the base year was 1976; and from January 1991 to the present, the base year has been 1985. The data between 1980 to 1990 are, thus, multiplied by the average monthly price index of 1976 divided by 100. The data from 1991 are multiplied by the average monthly price index of 1985 divided by 100.

Since the sample size covers the data from 1970 to 1996, the year at the mid-point of the sample, 1983, is chosen as the base year for computing P, and also for the following Paasche industrial output index (Y). Thus, P_{i0} is the arithmetic mean of the 12 monthly observations for 1983 of the five industrial price indexes, and Q_{i0} is the arithmetic mean of the 12 monthly observations for 1983 of the five industrial outputs.

The output index (Y) is the Paasche output index computed by the following formula:

$$Q_t^{Pa} = \frac{\sum_{i=1}^{5} P_{it} Q_{it}}{\sum_{i=1}^{5} P_{it} Q_{i0}}$$

where Q_{it} are the five industrial outputs mentioned earlier.

Data availability plays an important role in the choice of using the industrial output as the output measure, rather than some broader based measures, such as, GDP. Quarterly GDP is not available in Thailand. Monthly GDP is typically not available in most countries. Both industrial output and price indexes are products of our own calculation. In Thailand, it was not until 1995 that the monthly industrial (or manufacturing) price and output index became officially available. These newly available official indexes are unfortunately insufficient for the VAR estimation.

As a result, we have to compute our own output and price indexes from output and price data that were consistently been reported in the Bank of Thailand monthly bulletin from January 1970 to June 1996. As mentioned in Chapter Five, using monthly data may make the no-feedback assumption implied in the SAVR model probably more persuasive than otherwise might have been, had quarterly or annual data been used. Except for the inter-bank rate which is expressed as a percentage, all seven variables, including Y and P, are in logarithms.

In our empirical analysis, we will first use all the data available, that is, from January 1970 to June 1996, and then we will investigate two sub-periods: January 1970 to December 1984 and January 1985 to June 1996. The main reason for splitting the data into two sub-periods is to see the effect of changes caused by financial deregulation and

economic development since 1985. In Chapter Two, we explained that Thailand's financial system has undergone major changes, especially since the mid 1980s. These major changes include, among other things, financial deregulation, the introduction of modern technology in the banking operation, and the introduction of many new monetary and financial instruments.

In addition, the basket-pegged exchange rate system which was just abandoned in July 1997 had also been reintroduced in November 1984. The reintroduction of the basket-pegged system also marked the beginning of Thailand's decade-long rapid economic growth. According to the World Bank, during 1985-1995, Thailand was the world's fastest growing economy. To take into account Thailand's financial and economic development during the last decade, we will carry out empirical investigations using all the data available and data between the two sub-periods.

6.3. Estimations

6.3.a. Unit root tests

The first step in performing VAR is to check the stationarity of the variables. In Table 6.1, all of the seven variables are stationary in difference, i.e. they are all I(1). According to the standard form of ADF test: (I) and (II), the unit root hypothesis can be rejected if the t-test statistic is smaller than the critical value. In Table 6.1, the null hypothesis can only be rejected after the variables are transformed into the first difference, e.g $\Delta Y_t = Y_t - Y_{t-1}$. These results are hardly a surprise, as most macroeconomic time series are typically non-stationary, particularly nominal ones.

Table 6.1: Augmented Dickey-Fuller (ADF) Unit Root Test

Variables	Null Hypothesis Constant, No Trend	T- Statistic	Null Hypothesis Constant, Trend	T- Statistic
Y	A(1)=0	.37571[-2.57]	A(1)=0	-1.5799[-3.13]
	A(0)=A(1)=0	5.8323[3.78]	A(0)=A(1)=A(2)=0	4.8424[4.03]
			A(1)=A(2)=0	1.4657[5.34]*
Δ Y	A(1)=0	-4.8843[-2.57]*	A(1)=0	-4.9091[-3.13]*
	A(0)=A(1)=0	11.932[3.78]	A(0)=A(1)=A(2)=0	8.0408[4.03]
			A(1)=A(2)=0	12.057[5.34]
P	A(1)=0	-2.2664[-2.57]	A(1)=0	-2.0767[-3.13]
	A(0)=A(1)=0	5.5012[3.78]	A(0)=A(1)=A(2)=0	4.5082[4.03]
			A(1)=A(2)=0	3.8142[5.34]*
Δ P	A(1)=0	-3.3426[-2.57]*	A(1)=0	-3.7999[-3.13]*
	A(0)=A(1)=0	5.591[3.78]	A(0)=A(1)=A(2)=0	4.8497[4.03]
			A(1)=A(2)=0	7.2698[5.34]
M1	A(1)=0	-.0293[-2.57]	A(1)=0	-2.4588[-3.13]
	A(0)=A(1)=0	4.9779[3.78]	A(0)=A(1)=A(2)=0	5.4048[4.03]
			A(1)=A(2)=0	3.0398[5.43]*
Δ M1	A(1)=0	-3.9686[-2.57]*	A(1)=0	-3.964[-3.13]*
	A(0)=A(1)=0	7.875[3.78]	A(0)=A(1)=A(2)=0	5.2591[4.03]
			A(1)=A(2)=0	7.8886[5.34]
BC	A(1)=0	-0.3375[-2.57]	A(1)=0	-2.6538[-3.13]
	A(0)=A(1)=0	6.3511[3.78]	A(0)=A(1)=A(2)=0	6.6329[4.03]
			A(1)=A(2)=0	3.5215[5.34]*
Δ BC	A(1)=0	-4.916[-2.57]*	A(1)=0	-3.7104[-3.13]*
	A(0)=A(1)=0	12.086[3.78]	A(0)=A(1)=A(2)=0	4.6553[4.03]
			A(1)=A(2)=0	6.9803(5.34)
INTER	A(1)=0	-2.1909[-2.57]	A(1)=0	-2.2469[-3.13]
	A(0)=A(1)=0	2.4146[3.78]	A(0)=A(1)=A(2)=0	1.8827[4.03]*
			A(1)=A(2)=0	2.8096[5.34]*
Δ INTER	A(1)=0	-5.0922[-2.57]*	A(1)=0	-5.1414[-3.13]*
	A(0)=A(1)=0	12.965[3.78]	A(0)=A(1)=A(2)=0	8.8218[4.03]
			A(1)=A(2)=0	13.232[5.34]
TR	A(1)=0	0.27779[-2.57]	A(1)=0	-1.8109[-3.13]
	A(0)=A(1)=0	10.356[3.78]	A(0)=A(1)=A(2)=0	8.0939[4.03]
			A(1)=A(2)=0	1.7358[5.43]*
Δ TR	A(1)=0	-5.0742[-2.57]*	A(1)=0	-5.0941[-3.13]*
	A(0)=A(1)=0	12.875[3.78]	A(0)=A(1)=A(2)=0	8.6943[4.03]
			A(1)=A(2)=0	13.040[5.34]
DD	A(1)=0	-0.3375[-2.57]	A(1)=0	-2.366(-3.13)
	A(0)=A(1)=0	6.3511[3.78]	A(0)=A(1)=A(2)=0	6.1299(4.03)
			A(1)=A(2)=0	2.801(5.34)*
Δ DD	A(1)=0	-4.916[-2.57]*	A(1)=0	-4.904(-3.13)*
	A(0)=A(1)=0	12.086[3.78]	A(0)=A(1)=A(2)=0	8.028(4.03)
			A(1)=A(2)=0	12.043(5.34)

Numbers in parenthesis are asymptotic critical values at 10%
*significant at 10% level

The standard form of ADF test is based on the following models:

$$\Delta y_i = A(0) + A(1)y_t + \sum_{i=1}^{k} B_i \Delta y_{t-i} + \varepsilon_t \qquad \text{(with constant but no trend)} \quad \text{(I)}$$

$$\Delta y_i = A(0) + A(1)y_t + A(2)t + \sum_{i=1}^{k} B_i \Delta y_{t-i} + \varepsilon_t \quad \text{(with constant and trend)} \quad \text{(II)}$$

The unit root test is on A(1). The ADF test hinges essentially on the assumption that the error process is statistically independent and has a constant variance. Phillips and Perron (1988) developed a unit root test which allows for less rigid assumptions regarding the distribution of the error process. Monte Carlo studies found that the Phillips-Perron test also has greater power to reject a false null hypothesis of a unit root (Enders, 1995). Therefore, we will counter-check the ADF test with the Phillips-Perron test.

Table 6.2 shows results for the Phillips-Perron unit root test. It should be noticed that since the Phillips-Perron test is a generalized version of the Dickey-Fuller unit root tests, its test statistics are just modifications of the Dickey-Fuller t-statistics that take into account the less restrictive nature of the error process. However, the critical values in the Phillips-Perron test are the same as those in the Dickey-fuller tests. As in the ADF test, in the Phillips-Perron test the unit root hypothesis can be rejected if the *t*-test statistic is smaller than the critical value.

In Table 6.2, P and BC are unambiguously I(1). Y, M1, TR, and DD are less ambiguous, depending on whether or not trend is included. For example, Y has a unit root, if trend is excluded, but has no unit root, if trend is included. The most surprising

Table 6.2: Phillips-Perron Unit Root Test

Variables	Null Hypothesis Constant, No Trend	T-Statistic	Null Hypothesis Constant, Trend	T-Statistic
Y	A(1)=0	-0.33(-2.57)	A(1)=0	-4.01(-3.13)*
	A(0)=A(1)=0	3.99(3.78)	A(0)=A(1)=A(2)=0	7.69(4.03)
			A(1)=A(2)=0	8.01(5.34)
∆ Y	A(1)=0	-31.83(-2.57)*	A(1)=0	-31.83(-2.57)*
	A(0)=A(1)=0	506.64(3.78)	A(0)=A(1)=A(2)=0	336.62(4.03)
			A(1)=A(2)=0	506.6(3.78)
P	A(1)=0	-2.11(-2.57)	A(1)=0	-0.94(-3.13)
	A(0)=A(1)=0	15.89(3.78)	A(0)=A(1)=A(2)=0	10.6(4.03)
			A(1)=A(2)=0	2.31(5.34)*
∆ P	A(1)=0	-17.72(-2.57)*	A(1)=0	-17.9(4.03)*
	A(0)=A(1)=0	157.08(3.78)	A(0)=A(1)=A(2)=0	106.9(4.03)
			A(1)=A(2)=0	160.4(5.34)
M1	A(1)=0	-0.12(-2.57)	A(1)=0	-3.78(-3.13)*
	A(0)=A(1)=0	9.71(3.78)	A(0)=A(1)=A(2)=0	11.35(4.03)
			A(1)=A(2)=0	7.21(5.34)
∆ M1	A(1)=0	-13.3(-2.57)*	A(1)=0	-13.28(-3.13)*
	A(0)=A(1)=0	88.48(3.78)	A(0)=A(1)=A(2)=0	58.82(4.03)
			A(1)=A(2)=0	88.22(5.34)
BC	A(1)=0	0.71(-2.57)	A(1)=0	-1.16(-3.13)
	A(0)=A(1)=0	212.87(3.78)	A(0)=A(1)=A(2)=0	142.17(4.03)
			A(1)=A(2)=0	0.99(5.34)
∆ BC	A(1)=0	-11.41(-2.57)*	A(1)=0	-11.42(-3.13)*
	A(0)=A(1)=0	65.16(3.78)	A(0)=A(1)=A(2)=0	43.5(4.03)
			A(1)=A(2)=0	65.25(5.34)
INTER	A(1)=0	-3.53(-2.57)	A(1)=0	-3.53(-3.13)*
	A(0)=A(1)=0	6.25(3.78)	A(0)=A(1)=A(2)=0	4.2(4.03)
			A(1)=A(2)=0	6.3(5.34)
∆ INTER	A(1)=0	-15.96(-2.57)*	A(1)=0	-15.94(-3.13)*
	A(0)=A(1)=0	127.4(3.78)	A(0)=A(1)=A(2)=0	84.76(4.03)
			A(1)=A(2)=0	127.1(5.34)
TR	A(1)=0	-0.67(-2.57)	A(1)=0	-8.99(-3.13)*
	A(0)=A(1)=0	3.59(3.78)	A(0)=A(1)=A(2)=0	28.77(4.03)
			A(1)=A(2)=0	40.42(5.43)
∆ TR	A(1)=0	-32.47(-2.57)*	A(1)=0	-32.41(-3.13)*
	A(0)=A(1)=0	526.9(3.78)	A(0)=A(1)=A(2)=0	350.04(4.03)
			A(1)=A(2)=0	525.06(5.34)
DD	A(1)=0	-0.74(-2.57)	A(1)=0	-4.74(-3.13)*
	A(0)=A(1)=0	3.07(3.78)	A(0)=A(1)=A(2)=0	9.26(4.03)
			A(1)=A(2)=0	11.22(5.34)
∆ DD	A(1)=0	-23.45(-2.57)*	A(1)=0	-23.41(-3.13)*
	A(0)=A(1)=0	274.9(3.78)	A(0)=A(1)=A(2)=0	182.7(4.03)
			A(1)=A(2)=0	274.06(5.34)

Numbers in parenthesis are asymptotic critical values at 10%
*significant at 10% level

result is that INTER appears to be I(0) in the Phillips-Perron test. This result may stem from the fact that INTER is the only variable which is not in log. In the literature, interest rates are often found to be I(1), as is also the case for most other macroeconomic variables. As a result, in our SVAR estimation all the variables are in first-difference form[1]. For the sake of neatness, the first-difference sign (Δ) is to be omitted from all the seven variables referred to hereafter. One should, thus, bear in mind that these variables are all in first-difference, even though the first-difference sign (Δ) is not shown.

In performing unit root tests, structural breaks should also be taken into account. In the presence of structural breaks, Dickey-Fuller and Phillips-Perron test statistics are biased towards accepting the null-hypothesis of a unit root, even if the series may be stationary within each of the sub-periods. One of the easiest ways to test a unit root in the presence of structural breaks is to split the sample into two parts and then use Dickey-Fuller tests in each part (Enders, 1995). The ADF test is, thus, carried out on the proposed two sub-periods: 1970M1-1984M12 and 1985M1-1996M6. The results, not shown, confirm that all the variables are I(1).

6.3.b. Checking the order of VAR (the lag length)

Two selection criteria, Akaike information criterion (AIC) and Schwarz Bayesian criterion (SBC) are used to help select the lag length. According to these criteria, the model with the highest value of AIC and SBC should be chosen. In Table 6.3 and 6.4,

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[1] To allow for a possibility that INTER may, in fact, be I(0) and that results in the following tests could have changed significantly, had a different process of INTER been included in the model, we alternatively include INTER in level and in difference in the model. The empirical results are, however,

the order of the VAR model suggested by AIC and SBC is between zero and three. A zero lag is ruled out, as it would not be in the spirit of the VAR analysis.

As a result, the choice we have is between one and three lags. In Table 6.3 and 6.4, AIC and SBC tend to suggest a different lag length. SBC tends to suggest a lower lag length than does AIC. As mentioned in Chapter Five, if the dimension of the VAR is not so large, more lags may be needed to proxy omitted variables. However, too many lags are generally not recommended either, as degrees of freedom may be wasted. Therefore, whenever there is a conflicting recommendation by AIC and SBC, we will choose one which recommends a higher lag length.

It should be noticed that a common lag length is applied to all the variables or, in other words, in all equations in the models. The reason for this is that in the VAR model, a system of multi-regressions, each variable is regressed on its own lags and the lags of other variables in the model. Once the lag length is chosen, an econometric software program (Microfit Version 4 for this study) automatically estimates the VAR model with the same lag length in all equations.

6.3.c. Diagnostic Tests

The diagnostic tests shown in Tables 6.5 to 6.8 are for each of the four equations in Model A and B. Since our empirical analysis uses all the data available and the data between the two sub-periods, the results of the diagnostic tests for each of the three

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found to change only slightly. Therefore, for a sake of conformity in presenting the results we will only present the results in which INTER in difference is included.

Table 6.3: Choice Criteria Selecting the Order of the VAR (Model A)

Order	1970-1996		1970-1984		1984-1996	
	AIC	SBC	AIC	SBC	AIC	SBC
12	1230.9	866.3	732.2	426.6	498.6	211.7
11	1232.6	897.8	740.1	459.5	499.4	235.9
10	1223.5	918.4	744.4	488.7	493.4	253.4
9	1232.9	957.6	754.3	523.53	500.6	283.9
8	1227.2	981.6	760.2	554.4	499.5	306.3
7	1233.4	1017.7	759.8	578.9	507.5	337.7
6	1238.5	1052.5	759	603.1	516.9	370.6
5	1240.3	1084	756.1	625.1	517.7	394.8
4	1239.2	1112.7	759.9	653.9	523	423.5
3	1242.7	1146	762.1	681	530.2	454.1
2	**1245.6**	**1178.7**	**767.7**	711.6	**531.2**	**478.5**
1	1192.6	1155.4	747.2	**716.1**	503.4	474.2
0	1114.4	1107	700.2	693.9	471.4	465.6

Table 6.4 : Choice Criteria Selecting the Order of the VAR (Model B)

Order	1970-1996		1970-1984		1984-1996	
	AIC	SBC	AIC	SBC	AIC	SBC
12	2935.9	2571.3	1518.7	1213.1	1408.9	1122.1
11	2939	2604.2	1524.4	1243.7	1403.1	1139.7
10	2938.8	2633.8	1527.7	1272.1	1409.3	1169.3
9	2938.9	2663.6	1531.6	1300.9	1409.3	1192.7
8	2946.4	2700.9	1541.5	1335.8	1421.5	1228.3
7	2943.5	2727.7	1544	1363.1	1421.2	1251.4
6	2945.4	2759.4	1548.5	1392.6	1426.7	1280.4
5	2939	2782.7	1538.6	1407.7	1422.2	1299.2
4	2947.9	2821.4	1546.4	1440.4	1433	1333.5
3	**2960.8**	2864.1	1557.1	1476	1438.5	1362.3
2	2960.1	2893.2	**1559**	1502.9	**1440**	1387.3
1	2936.9	**2899.7**	1552.7	1521.5	1429.4	1400.1
0	2894	2886.5	1533.3	**1527.1**	1414.9	**1409**

Table 6.5: Diagnostic Tests for INTER and TR Equations (Model A)

		INTER			TR		
		1970-96	1970-84	1985-96	1970-96	1970-84	1985-96
Serial Correlation	LM Version	**33.6[.001]**	16.5[.168]	**27.7[.006]**	**34[.001]**	**34.5[.001]**	16.6[.165]
	F Version	**2.9[.001]**	1.3[.202]	**2.45[.007]**	**2.9[.001]**	**3.15[.000]**	1.3[.209]
Functional Form	LM Version	1.3[.249]	1.3[.238]	.533[.456]	3.3[.112]	1.1[.293]	3.9[.108]
	F Version	1.2[.256]	1.3[.251]	.497[.482]	3.2[.113]	1.0[.307]	3.8[.110]
Normality	LM Version	**9.6[.008]**	**29[.000]**	.693[.707]	**9.08[.011]**	2.7[.251]	**7.5[.023]**
	F Version	na	na	na	na	na	na
Heteroscedasticity	LM Version	1.2[.273]	**4.8[.028]**	.276[.599]	1.9[.160]	1.9[.164]	.03[.853]
	F Version	1.2[.274]	**4.9[.028]**	.273[.602]	1.9[.161]	1.9[.166]	.03[.855]

Numbers in brackets are marginal significance levels

Table 6.6: Diagnostic Tests for DD and BC Equations (Model A)

		DD			BC		
		1970-96	1970-84	1985-96	1970-96	1970-84	1985-96
Serial Correlation	LM Version	**27.0[.008]**	**36[.000]**	8.3[.758]	**25.4[.013]**	13.7[.317]	**35[.000]**
	F Version	**2.3[.008]**	**3.3[.000]**	.62[.816]	**2.1[.014]**	1.0[.368]	**3.3[.000]**
Functional Form	LM Version	1.9[.168]	2.2[.133]	0.18[.667]	.26[.607]	.48[.485]	.002[.961]
	F Version	1.8[.174]	2.1[.144]	.17[.679]	.25[.613]	.46[.498]	.002[.962]
Normality	LM Version	**8.6[.013]**	2.4[.295]	.72[.696]	**6.2[.045]**	1.4[.483]	.13[.937]
	F Version	na	na	na	na	na	na
Heteroscedasticity	LM Version	**5.0[.024]**	2.0[.157]	1.5[.219]	2.4[.115]	1.9[.165]	.008[.926]
	F Version	**5.1[.024]**	2.0[.158]	1.5[.222]	2.4[.116]	1.9[.167]	.008[.927]

Numbers in brackets are marginal significance levels

Table 6.7: Diagnostic Tests for BC and M1 Equations (Model B)

		BC			M1		
		1970-96	1970-84	1985-96	1970-96	1970-84	1985-96
Serial Correlation	LM Version	**24.2[.019]**	12.9[.375]	**35.0[.000]**	9.4[.667]	**22.3[.034]**	4.5[.971]
	F Version	**2.0[.023]**	1.0[.430]	**3.3[.000]**	.744[.707]	**1.8[.040]**	.33[.981]
Functional Form	LM Version	.34[.556]	.001[.970]	.61[.434]	.33[.565]	2.5[.109]	2.8[.148]
	F Version	.33[.565]	.001[.971]	.56[.452]	.31[.574]	2.4[.119]	2.7[.156]
Normality	LM Version	**19.3[.000]**	2.7[.252]	.04[.977]	**7.7[.021]**	**10.0[.006]**	.34[.843]
	F Version	na	na	na	na	na	na
Heteroscedasticity	LM Version	1.4[.235]	1.9[.160]	.71[.398]	.76[.383]	.03[.860]	.31[.572]
	F Version	1.4[.237]	1.9[.162]	.70[.401]	.75[.385]	.03[861]	.31[.575]

Numbers in brackets are marginal significance levels

Table 6.8: Diagnostic Tests Y and P Equations (Model B)

		Y			P		
		1970-96	1970-84	1985-96	1970-96	1970-84	1985-96
Serial Correlation	LM Version	8.5[.739]	14.3[.280]	19.3[.081]	6.3[.899]	11.0[.526]	10.5[.568]
	F Version	.67[.774]	1.14[.328]	1.5[.104]	.49[.917]	.86[.585]	.80[.643]
Functional Form	LM Version	2.3[.125]	.56[.450]	2.3[.124]	.2E-4[.99]	1.2[.264]	.05[.814]
	F Version	2.2[.133]	.53[.464]	2.2[.138]	.2E-4[.99]	1.1[.278]	.05[.821]
Normality	LM Version	2.9[.229]	.22[.892]	**8.0[.018]**	**7793[.00]**	**3368[.00]**	**110[.00]**
	F Version	na	na	na	na	na	na
Heteroscedasticity	LM Version	**6.0[.014]**	1.1[.273]	2.5[.110]	**13.3[.000]**	3.5[.061]	1.0[.300]
	F Version	**6.1[.014]**	1.1[.276]	2.5[.111]	**13.8[.000]**	3.5[.062]	1.0[.304]

Numbers in brackets are marginal significance levels

periods 1970-96, 1970-84 and 1985-96 are also provided. The test statistics of four diagnostic tests (serial correlation; functional form; normality; and heteroscedasticity) are reported here.The null hypotheses for these four diagnostic tests are that there is no serial correlation (disturbances are serially uncorrelated), functional form misspecification, non-normality (disturbances are normally distributed) and heteroscedasticity (error-variances are constant or homoscedasticity) respectively.

In Tables 6.5 to 6.8, the functional form misspecification does not seem to be a problem since the null hypothesis of no functional form misspecification cannot be rejected in both models. Heteroscedasticity is, however, found in INTER, DD, Y, and P equations. In the presence of heteroscedasticity, ordinary least squares (OLS) estimators are still unbiased but inefficient. But the estimates of the variances are biased, invalidating the tests of significance for parameters. In the VAR analysis, parameters are typically not of interest, and hence the effects of heteroscedasticity on the tests of significance should not be of major concern.

One of the traditional remedies usually prescribed for solving the heteroscedasticity is transforming the data to logs to reduce the heteroscedasticity in the error variances. This is exactly what we have done, all the data (except INTER) are transformed to logs; but still there is no guarantee that the heteroscedasticity can be entirely eliminated. Nonetheless, the heteroscedasticity does not seem to be so rampant. TR, BC (in both models) and M1 equations have no heteroscedasticity at all. Breaking down the data in sub-periods seems to help alleviate the problem; the heteroscedasticity disappears in DD, Y, and P sub-period equations.

Serial correlation is found in all, but Y and P equations. The consequences of autocorrelated errors are unbiased but inefficient OLS estimators and biased error variances, which could exaggerate *t* and *F* statistics. According to Maddala (1988), one of the factors that could lead to the presence of serial correlation is that some variables that should have been included in the equations are omitted, and these omitted variables are themselves autocorrelated. In our empirical analysis, there are only four variables in each model. It is, thus, possible that some variables that should have been included in the model may have been omitted.

However, expanding the models to include more variables to accommodate the possible serial correlation may complicate the empirical analysis, and make it extremely difficult to provide a sensible theoretical justification for the inclusion of new variables. As a result, we will adhere to our proposed models by making no modification to the models, even though this may come at the price of having some serial correlation.

Normality appears to be of major concern, as the null hypothesis of normally distributed errors can be rejected in every equation, albeit not in all sub-period equations. Splitting the data into two groups seems to help in some cases, such as, in DD and BC equations. According to Darnell (1994), a significant test statistic of the normality test which rejects the null hypothesis of normally distributed errors, can be interpreted as an indication of outliners (observations substantially different from the rest of the observations), since the larger is the proportion of large residuals the less likely is the null hypothesis of normality.

If a data set is found to contain outliners, then a common response is to delete those particular observations and re-estimate the equations. This simple response may, however, be problematic in practice, and, without proper justification, could be arbitrary. In the VAR estimation, a sufficiently large number of observations are needed, especially when we have to investigate two sub-periods. As a result, we choose not to delete any observation and press on with the VAR estimation with all the data we have.

6.3.d. Testing whether contemporaneous covariances between shocks in different equations are correlated

As discussed in Chapter Five, in the SVAR model the Choleski decomposition implies the ordering of variables and a recursive structure of the underlying structural residuals (Wold causal representation). The importance of the ordering depends on the magnitude of the correlation coefficients between the disturbances. If the correlation coefficients were small, the Wold ordering should have little effect on variance decomposition and impulse response function results, if the ordering was altered.

In Table 6.9 and 6.10, it can be seen that contemporaneous covariances between the shocks in both models are very small. To check whether these covariances (the off-diagonal elements of the covariance matrix of the errors) are statistically significant from zero, the log-likelihood ratio (LR) test is used. A null hypothesis that the shocks in different equations are contemporaneously uncorrelated is tested against an alternative hypothesis that they are contemporaneously correlated.

Table 6.9: Estimated System Covariance Matrix of Errors (Model A)

(1970-1996)

	INTER	TR	DD	BC
INTER	1.3555			
TR	-0.0059735	0.0079034		
DD	-0.016054	0.0019664	0.0035098	
BC	0.0014339	-0.0007002	0.0004117	0.00097

(1970-1984)

	INTER	TR	DD	BC
INTER	0.58865			
TR	-0.0048025	0.0080957		
DD	0.0015135	0.0020235	0.0023181	
BC	0.0015448	-0.0005397	0.0004574	0.0001243

(1985-1996)

	INTER	TR	DD	BC
INTER	2.3776			
TR	-0.011443	0.0073109		
DD	-0.040014	0.0018673	0.0052013	
BC	0.0017674	-0.0007297	0.0003671	0.0006145

Table 6.10: Estimated System Covariance Matrix of Errors (Model B)

(1970-1996)

	BC	M1	Y	P
BC	0.0009614			
M1	0.000323	0.005061		
Y	0.0003956	0.0008636	0.00285	
P	0.00001912	-0.0001045	0.000425	0.002626

7(1970-1984)

	BC	M1	Y	P
BC	0.00129			
M1	0.000308	0.003803		
Y	0.00001239	0.0005367	0.0035221	
P	-0.0000475	-0.0000865	0.0001731	0.003947

(1985-1996)

	BC	M1	Y	P
BC	0.0006177			
M1	0.0002007	0.006745		
Y	0.0008852	0.001313	0.0020102	
P	0.0000087	0.0001155	0.0006028	0.001043

Table 6.11: Log-likelihood Ratio Test for Covariance Correlation (Model A)

Equation Log-likelihood	1970-96	1970-84	1985-96
INTER	-490	-199	-250
TR	319	179	148
DD	447	290	171
BC	1013	549	447
LL_R	1289	819	516
LL_U	1329	846	567
Log-likelihood Ratio Statistic	80	54	102

Table 6.12: Log-likelihood Ratio Test for Covariance Correlation (Model B)

Equation Log-likelihood	1970-96	1970-84	1985-96
BC	1013	546	477
M1	752	450	316
Y	481	253	237
P	855	447	441
LL_R	3101	1696	1471
LL_U	3108	1698	1476
Log-likelihood Ratio Statistic	14	4	10

The log-likelihood (LR) test statistic is given by

$$LR(H_0 / H_1) = 2(LL_u - LL_R)$$

where LL_u and LL_R are the maximized values of the LR function under the alternative and the null hypotheses respectively. This LR statistic has a χ^2 distribution.

In Table 6.11 and 6.12, LL_u is the value of the "system log-likelihood", and LL_R is the summation of the single equation log-likelihood values of the four equations. The 95%, 99%, and 99.5% critical values of the χ^2 distribution with 6 degrees of freedom are 12.6, 16.6, and 18.5 respectively. According to these critical values, the null hypothesis in model A can be rejected at any of the three critical values. In model B, the null hypothesis cannot be rejected at the 95% critical value for period (1970-84) and (1985-1996). For period (1970-1996), the null hypothesis cannot be rejected at 99%.

Although there is a possibility that contemporaneous covariances between the shocks are non-zero A, the impact of the covariance correlation is likely to be minimal, since the magnitude of the covariance between the shocks is very small. The variance decomposition and the impulse response function results are found to be virtually unchanged when the ordering of the variables is experimentally altered.

After undertaking all the tests important for the VAR estimation, we now proceed to estimate the VAR model. In our study, two models are to be estimated. Model A deals with the financial sector, and will test the transmission of monetary policy through the lending channel. Model B deals with the real economy sector, and will test the forecasting power of money and credit shocks. As explained in Chapter Five, the inter-

bank rate (INTER) is used as a proxy of monetary policy stance. For example, a policy-driven rise in INTER is expected to induce banks to squeeze their reserves in the short-run. Monetary tightening should lead to a fall in loans and deposits in the banking system. Loans are, however, unlikely to fall dramatically in the short run possibly due to their quasi-contractual nature and the existence of bank liability management. But over time it is expected that loans and deposits will eventually fall.

The ability of the central bank to affect the scale of bank balance sheets is, in fact, not controversial and is widely accepted as part of both the coventional money channel and the lending channel (Bernanke, 1993). However, what appears to be controversial is how a reduction in bank assets and liabilities goes on to affect the economy. In the conventional money view, the critical effect comes from a reduction in bank liabilities (deposits). In the lending view, a fall in bank assets is considered potentially important in the transmission of the monetary policy. To see the relative importance of money and credit aggregates in monetary policy transmission, Model B will examine the relative importance of the forecasting power of money and credit shocks.

In each model, two questions are asked: what is the relative importance of exogenous shocks to movements in endogenous variables? and what is the dynamic response of endogenous variables to exogenous shocks? The first question is answered by variance decomposition. The second question is answered by the impulse response function.

6.4. Results

6.4.a. Model A

In Model A, we want to analyze the inter-relationship or inter-dependence between four time-series financial variables: inter-bank rate (INTER), total bank reserves (TR), demand deposits (DD), and bank credit (BC). We first look at the results for the variance decomposition. Remember that the forecast error variance decomposition imparts the proportion of the movements in one variable, say, INTER, due to its own shocks versus shocks to the other variables, that is, TR, DD and BC. For example, if TR, DD, BC (disturbance) shocks explain none of the forecast error variance of INTER at all forecast horizons, then INTER would be exogenous (or evolve independently) of TR, DD, and BC (disturbance) shocks.

In Table 6.13, it can be seen that BC shocks explain about 3% of INTER's forecast error variance, TR and DD shocks explain around 1%[2]. These results are not unexpected, given that the inter-bank rate is one of the most important costs for acquiring reserves. Other things being equal, a rise in bank lending would put upward pressure on the inter-bank rate. In Table 6.14, it is interesting to see that BC shocks contributed to INTER's forecast error variance during 1970-1984 more than during 1985-1996.

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[2]Granger non-causality test discussed later will explain how statistically significant these variables and other variables in the study are. It may be noticed that the contribution of a variable's own shocks to its forecast error variance tends to be far larger than that of other variables' shocks. This seems to be the case not only for INTER but also for most other variables under the study. Two factors are discovered to be influential to these outcomes: lag length and time horizon. If lag length and time horizon are elongated, the contribution of a variable's own shocks are found to decrease, while that of other variables' shocks increases. However, the overall relative contribution remains, by and large, unchanged.

Table 6.13: Forecast Error Variance Decomposition of INTER in Percentage at 24-month Horizon (1970-1996)

Horizon	INTER	TR	DD	BC
1	95.985	0.679	1.2203	2.1155
6	94.676	0.938	1.221	3.1646
12	94.652	0.945	1.2224	3.1807
18	94.651	0.946	1.2224	3.1808
24	94.651	0.946	1.2224	3.1808

Table 6.14: Forecast Error Variance Decomposition of INTER in Percentage at 24-month Horizon (1970-1984) and (1985-1996)

Horizon	INTER		TR		DD		BC	
	70-84	85-96	70-84	85-96	70-84	85-96	70-84	85-96
1	95.483	95.938	0.44662	0.98799	0.44851	1.2245	3.5853	1.8497
6	93.778	94.449	0.54036	1.5281	0.53233	1.3381	5.1489	2.6845
12	93.76	94.371	0.54626	1.5387	0.53388	1.3427	5.1603	2.7472
18	93.759	94.368	0.54639	1.539	0.53391	1.3428	5.1603	2.7499
24	93.759	94.368	0.54639	1.539	0.55339	1.3428	5.1603	2.7501

Table 6.15: Forecast Error Variance Decomposition of TR in Percentage at 24-month Horizon (1970-1996)

Horizon	INTER	TR	DD	BC
1	0.20768	98.398	1.3938	0.00067
6	0.61956	96.421	2.9329	0.2687
12	0.61814	96.373	2.9799	0.2877
18	0.61812	96.373	2.9804	0.2881
24	0.61812	96.373	2.9804	0.2881

Table 6.16: Forecast Error Variance Decomposition of TR in Percentage at 24-month Horizon (1970-1984) and (1985-1996)

Horizon	INTER		TR		DD		BC	
	70-84	85-96	70-84	85-96	70-84	85-96	70-84	85-96
1	0.40775	0.45967	94.387	99.488	5.2044	0.477	0.00566	0.00446
6	0.40863	1.3565	91.205	96.254	8.122	0.73714	0.00265	1.6522
12	0.40444	1.35504	91.08	96.205	8.2502	0.75547	0.26551	1.6889
18	0.40436	1.3506	91.078	96.203	8.2523	0.75595	0.26504	1.6902
24	0.40435	1.3506	91.078	96.203	8.2524	0.75597	0.26504	1.6902

Table 6.17: Forecast Error Variance Decomposition of DD in Percentage at 24-month Horizon (1970-1996)

Horizon	INTER	TR	DD	BC
1	4.572	17.158	77.058	1.1851
6	4.505	19.473	74.396	1.6251
12	4.4958	19.647	74.236	1.6214
18	4.4956	19.651	74.233	1.6213
24	4.4956	19.651	74.232	1.6213

Table 6.18: Forecast Error Variance Decomposition of DD in Percentage at 24-month Horizon (1970-1984) and (1985-1996)

Horizon	INTER		TR		DD		BC	
	70-84	85-96	70-84	85-96	70-84	85-96	70-84	85-96
1	0.22118	11.389	26.799	10.213	72.09	76.338	0.88994	2.0601
6	0.34002	11.401	29.519	11.857	69.038	73.287	1.1034	3.4554
12	0.33885	11.382	29.702	12.015	68.858	73.151	1.1004	3.4525
18	0.33883	11.381	29.707	12.018	68.854	73.148	1.1003	3.4525
24	0.33883	11.381	29.707	12.018	68.854	73.148	1.1003	3.4525

Table 6.19: Forecast Error Variance Decomposition of BC in Percentage at 24-month Horizon (1970-1996)

Horizon	INTER	TR	DD	BC
1	1.6364	1.1518	5.324	91.888
6	1.4259	1.1679	4.9875	92.419
12	1.4229	1.1821	4.9875	92.408
18	1.4228	1.1823	4.9875	92.407
24	1.4228	1.1823	4.9875	92.407

Table 6.20: Forecast Error Variance Decomposition of BC in Percentage at 24-month Horizon (1970-1984) and (1985-1996)

Horizon	INTER		TR		DD		BC	
	70-84	85-96	70-84	85-96	70-84	85-96	70-84	85-96
1	3.1592	2.2192	0.42181	3.3016	5.8262	7.1489	90.593	87.33
6	3.4446	2.0468	0.42316	2.0689	5.5507	6.5939	90.582	88.29
12	3.4456	2.0267	0.42858	3.0744	5.5536	6.5884	90.572	88.311
18	3.4456	2.0258	0.42869	3.0731	5.5536	6.5879	90.572	88.313
24	3.4456	2.0258	0.42869	3.073	5.5536	6.5879	90.572	88.313

Financial development since 1985 may hold the key to these results. As shown in Table 2.5 (Chapter Two), in post financial deregulation, the commercial banks have become heavily dependent on external short-term borrowing: financial liberalization made it easier for them to obtain external funds. Prior to July 2, 1997, the Thai government's policy of maintaining a stable exchange rate also provided a major incentive for the banks to borrow overseas. The commercial banks' increased reliance on external borrowing during the first half of the 1990s may, to a significant extent, have weakened the relationship between BC and INTER, as external short-term funds can be acquired easily. Thailand's worst financial crisis in 1997 is a classic example of over-borrowing by the financial institutions.

Table 6.15 shows the forecast error variance decomposition of total bank reserves (TR). DD shocks explain approximately 3% of TR's forecast error variance, relatively much more than INTER and BC shocks. But when comparing the results from the two sub-periods, the relationship between TR and DD appears to weaken during 1985-96. During 1970-84, DD shocks account for over 8% of TR's forecast error variance, whereas during 1985-96, DD shocks account for less than 1% (Table 6.16).

These results may be attributable to changes in the banks' funding behaviour. In Table 2.6 (Chapter Two), the proportion of bank funding from deposits remains relatively stable, though declining somewhat between 1994-1995, while that from borrowing increases significantly from around 11% to over 24%. Apart from borrowing, the commercial banks also have many other ways of raising short-term and long-term

funds. Certificates of deposit were introduced in the early 1990s, and many other new financial instruments were also introduced into the market (see details in Chapter Two).

Tables 6.17 and 6.18 reaffirm a link between TR and DD and also show that TR shocks are more important to DD than DD shocks to TR. In Table 6.17, TR shocks account for nearly 20% of DD's forecast error variance. Table 6.18 shows that while TR shocks become less important to DD during 1985-1996 (as is also the case for DD shocks to TR discussed above), INTER shocks become more important, increasing from just 0.34% to over 11%. In Table 6.19, DD shocks are relatively the most important shocks to BC's forecast error variance. The relationship between BC and DD remains, more or less, stable over the two sub-periods (Table 6.20).

From the results discussed so far, it can be said that TR is important to DD and DD is, in turn, important to BC. This relationship seems to be, by and large, in line with what is discussed in the previous chapter. However, one can argue the inter-relationship between TR, DD, and BC may be just a result of the ordering of the variables in the VAR model. As discussed in Section 6.3.d the correlation coefficients between TR and DD and DD and BC are so low that the Wold ordering should have little effect. That is, if the ordering of TR and DD in the VAR model were swapped, the variance decomposition and impulse response function would change only slightly.

After examining the variance decomposition, we now look into the dynamic response of each variable to exogenous shocks (i.e. shocks generated by other variables and own disturbance). In the impulse response function, we will look at how the inter-bank rate

(INTER), total reserves (TR), demand deposits (DD), and bank credit (BC) respond to changes in monetary policy. The inter-bank rate is used as a proxy of monetary policy stance. This means that we identify the disturbances to the inter-bank rate equation in the VAR as shocks to monetary policy, and interpret the responses of other variables in the system to the INTER shocks as the structural responses of those variables to an unanticipated change in monetary policy.

Figure 6.1 to 6.4 show the estimated dynamic responses of INTER, TR, DD, and BC to a positive one-standard-deviation shock to the inter-bank rate, interpreted as an unanticipated tightening of monetary policy. Since all of the variables except the inter-bank rate are measured in logs, the response can be interpreted as proportions (i.e 0.001 = 0.1 percent) of the baseline levels.

In Figure 6.1, after rising sharply initially, INTER starts to fall precipitously after two months. Within nine months, the inter-bank rate quickly returns to its baseline level. Figure 6.2 illustrates that TR falls after a tightening of monetary policy and then fluctuate up and down before tailing off after twenty one months. Figure 6.3 shows DD jumping sharply before beginning to return to the baseline path in seven months. Figure 6.4 shows that BC also rises sharply after monetary policy is tightened, and then falls to the baseline path in twelve months.

Figure 6.1:Orthogonalized Impulse Response of INTER to One SE Shock to INTER

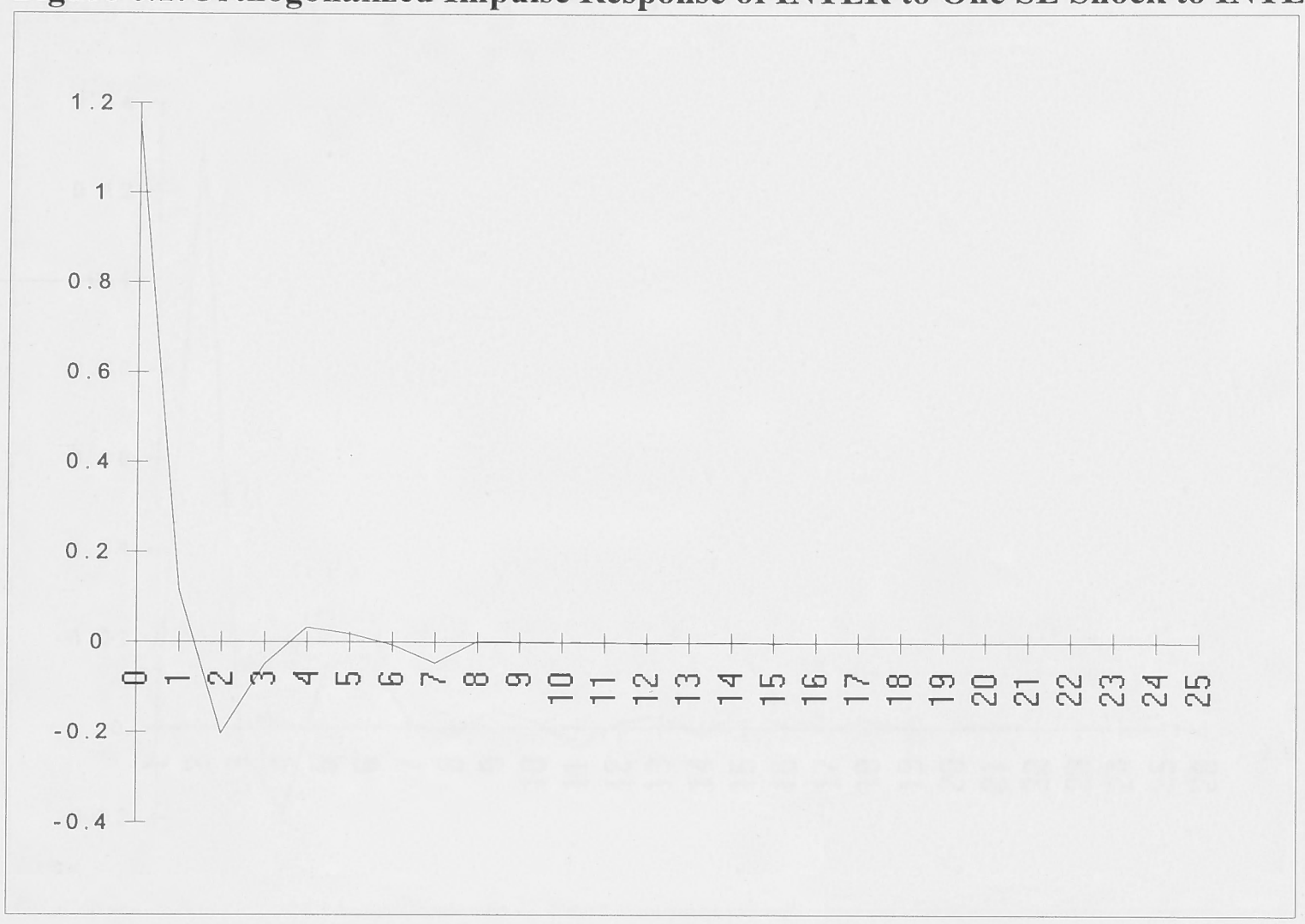


Figure 6.2: Orthogonalized Impulse Response of TR to One SE Shock to INTER

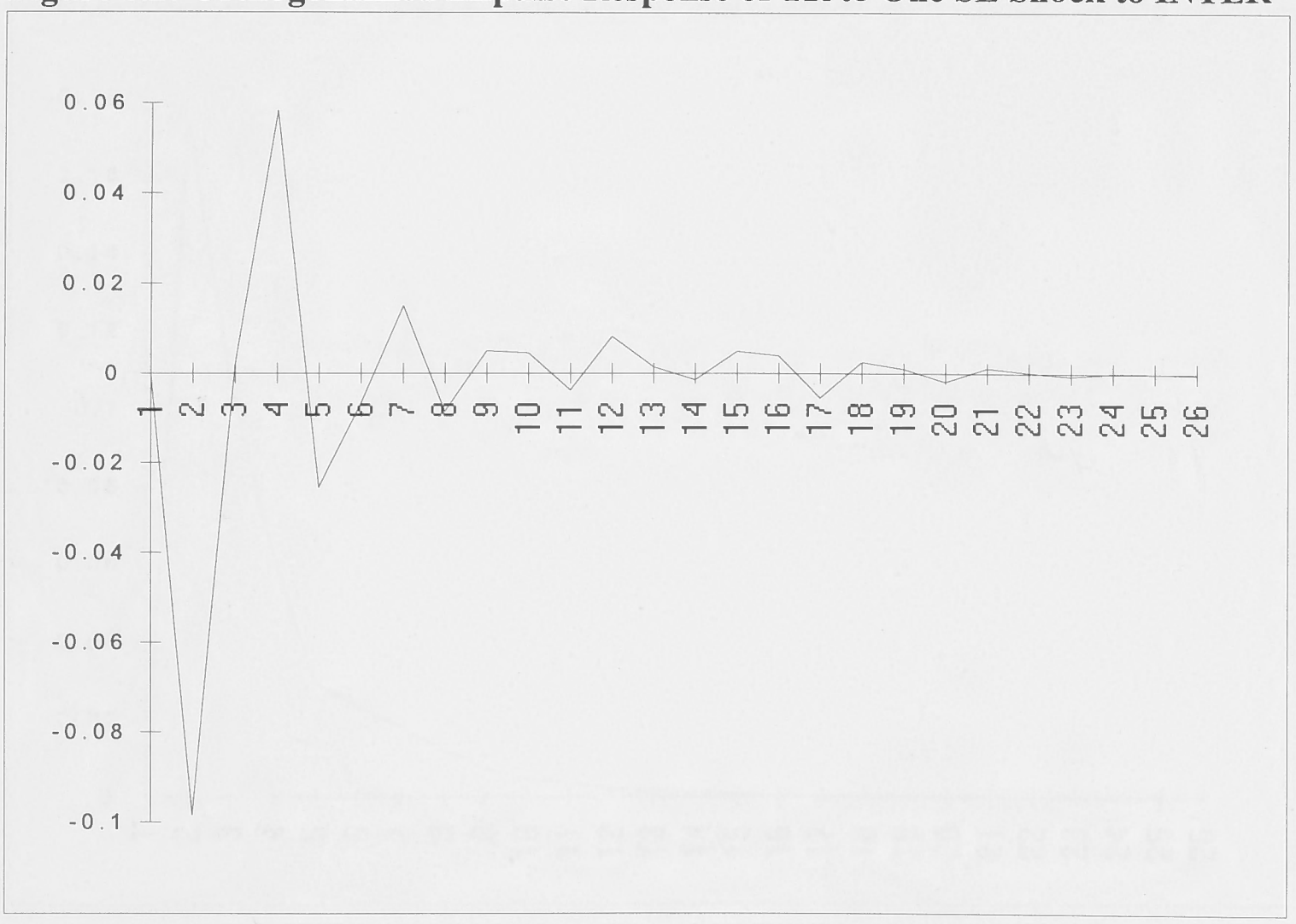


Figure 6.3: Orthogonalized Impulse Response of DD to One SE Shock to INTER

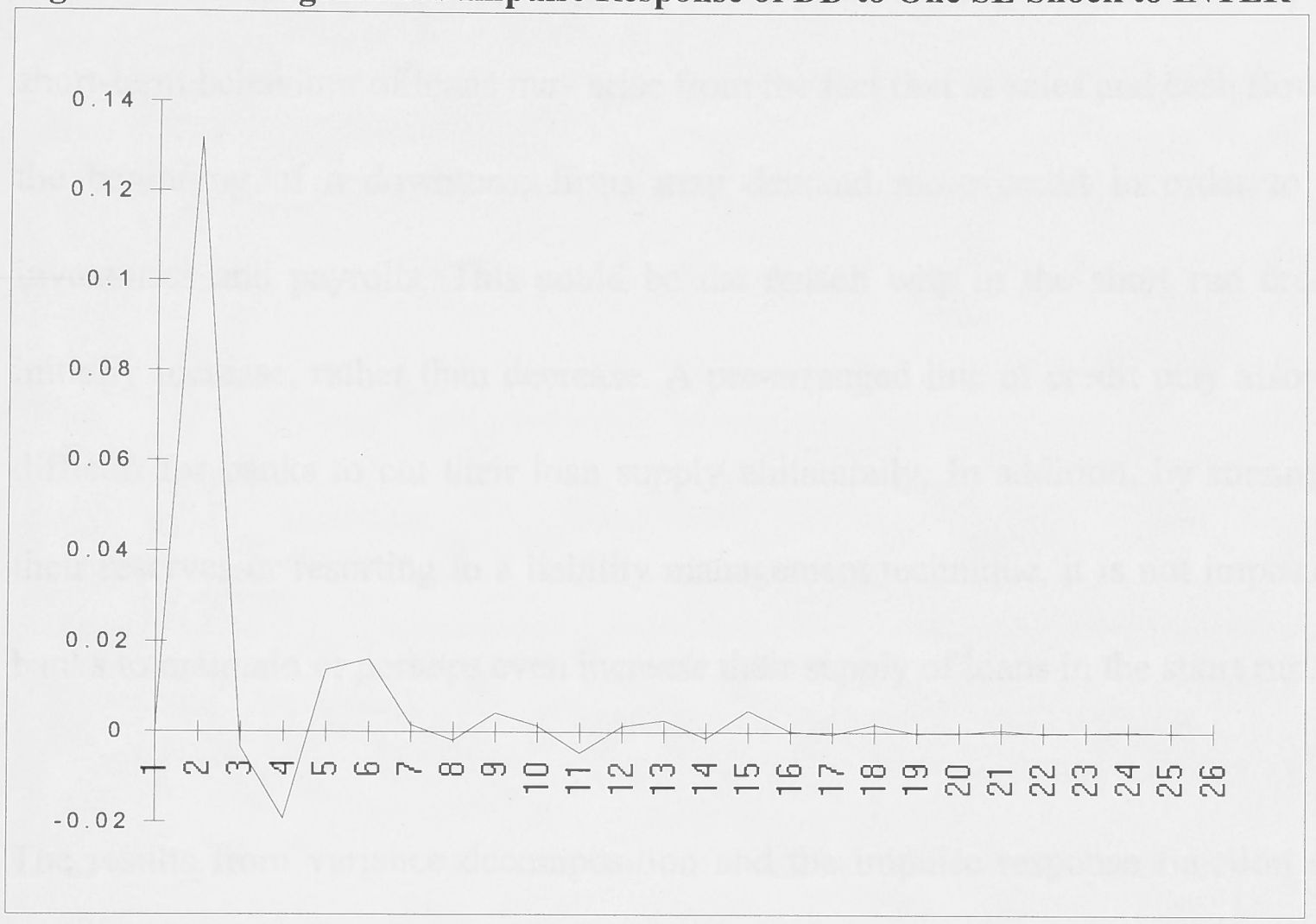
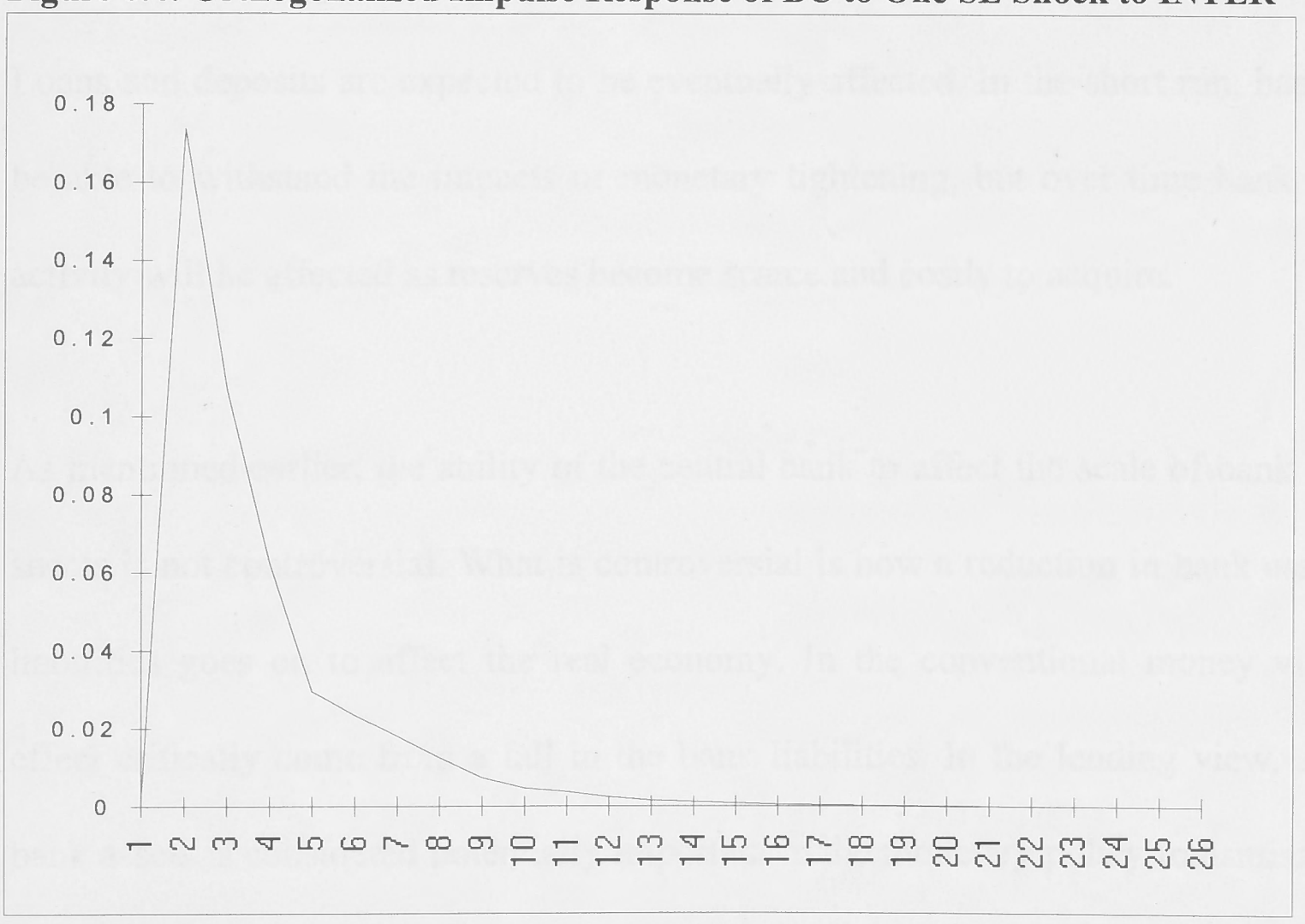


Figure 6.4: Orthogonalized Impulse Response of BC to One SE Shock to INTER



Bernanke and Blinder (1990) suggest that a plausible explanation for a "perverse" short-term behaviour of loans may arise from the fact that as sales and cash flows fall at the beginning of a downturn, firms may demand more credit in order to finance inventories and payrolls. This could be the reason why in the short run credit may initially increase, rather than decrease. A pre-arranged line of credit may also make it difficult for banks to cut their loan supply unilaterally. In addition, by running down their reserves or resorting to a liability management technique, it is not impossible for banks to maintain or perhaps even increase their supply of loans in the short run.

The results from variance decomposition and the impulse response function seem to vindicate, more or less, what we discuss in our theoretical model that monetary tightening resulting in reserve losses would affect the scale of bank balance sheets. Loans and deposits are expected to be eventually affected. In the short run, banks may be able to withstand the impacts of monetary tightening, but over time bank lending activity will be affected as reserves become scarce and costly to acquire.

As mentioned earlier, the ability of the central bank to affect the scale of bank balance sheets is not controversial. What is controversial is how a reduction in bank assets and liabilities goes on to affect the real economy. In the conventional money view, the effect critically come from a fall in the bank liabilities. In the lending view, a fall in bank assets is considered potentially important in the monetary policy transmission. To see the relative importance of money and credit aggregates in monetary policy transmission, the following section will examine the relative importance of the forecasting power of money and credit shocks.

6.4.b. Model B

In Model B, we first look at the inter-relationship between four time-series variables: bank credit (BC), narrow money supply (M1), industrial output index (Y), and industrial output price index (P). In Table 6.21, M1 shocks contribute slightly more to BC's forecast error variance than P and Y shocks. Table 6.22 shows that during 1985-1996 Y shocks explain more of BC's forecast error variance than M1 and P shocks by a clear margin of 5.19 %.

It is very intriguing to see that BC shocks are more important to the forecast error variance of Y and P than M1 shocks. Tables 6.25 and 6.27 show that on the overall data span, BC fares better than M1 in explaining the future error variance of Y and P. These result seems to lend support to the lending view's call for the recognition of bank loans in monetary policy transmission. However, one may argue that a poor performance of M1 could be attributable to financial liberalization and innovation. Prior to financial liberalization, the central role of banks in issuing liquid liabilities functioning as "money" ensured that bank deposits and currency (that is M1) had a reasonably close relationship with major macroeconomic variables, such as price and output. Financial liberalization and innovation have, however, undermined this role.

Since the mid 1980s, many new financial products which are close substitutes to money have been introduced. These include a number of non-M1 assets which can readily substitute for the transaction assets in M1. M1 now contains saving-type assets subject to portfolio redistribution. Traditionally, assets in M1 do not earn interest, so M1 is considered not to be subject to the portfolio redistribution impact affecting the

Table 6.21: Forecast Error Variance Decomposition of BC in Percentage at 24-month Horizon (1970-1996)

Horizon	BC	M1	Y	P
1	97.767	1.0042	0.25552	0.97343
6	93.751	2.2768	1.8559	2.1163
12	93.627	2.343	1.8638	2.166
18	93.623	2.3451	1.8639	2.1676
24	93.623	2.3452	1.8639	2.1677

Table 6.22: Forecast Error Variance Decomposition of BC in Percentage at 24-month Horizon (1970-1984) and (1985-1996)

Horizon	BC		M1		Y		P	
	70-84	85-96	70-84	85-96	70-84	85-96	70-84	85-96
1	98.229	97.56	0.55967	2.4339	0.15633	0.00975	1.0553	0.05344
6	97.568	92.487	0.60439	2.0255	0.81087	5.2085	1.0164	0.27873
12	97.566	92.498	0.60502	2.0123	0.81271	5.1996	1.0161	0.29039
18	97.566	92.498	0.60502	2.0118	0.81272	5.1991	1.0161	0.29086
24	97.566	92.498	0.60502	2.0118	0.81272	5.199	1.0161	0.29088

Table 6.23: Forecast Error Variance Decomposition of M1 in Percentage at 24-month Horizon (1970-1996)

Horizon	BC	M1	Y	P
1	2.1216	97.44	0.02212	0.4353
6	2.5395	94.898	1.2422	1.3198
12	2.5474	94.853	1.2656	1.3335
18	2.5474	94.853	1.2657	1.3335
24	2.5474	94.853	1.2657	1.3335

Table 6.24: Forecast Error Variance Decomposition of M1 in Percentage at 24-month Horizon (1970-1984) and (1985-1996)

Horizon	BC		M1		Y		P	
	70-84	85-96	70-84	85-96	70-84	85-96	70-84	85-96
1	1.8839	1.2015	96.124	98.645	1.0549	0.14561	0.93678	0.08185
6	1.9408	1.6346	95.349	95.415	1.3426	2.8773	1.368	0.7298
12	1.941	1.6445	95.341	95.403	1.3493	2.8796	1.3683	0.7321
18	1.941	1.645	95.341	95.402	1.3494	2.8797	1.3683	0.7322
24	1.941	1.645	95.341	95.402	1.3494	2.8797	1.3683	0.7322

Table 6.25: Forecast Error Variance Decomposition of Y in Percentage at 24-month Horizon (1970-1996)

Horizon	BC	M1	Y	P
1	0.42919	0.26487	99.169	0.13692
6	1.1076	0.29683	96.867	1.7287
12	1.1143	0.30175	96.845	1.7392
18	1.1143	0.30176	96.845	1.7393
24	1.1143	0.30176	96.845	1.7393

Table 6.26: Forecast Error Variance Decomposition of Y in Percentage at 24-month Horizon (1970-1984) and (1985-1996)

Horizon	BC		M1		Y		P	
	70-84	85-96	70-84	85-96	70-84	85-96	70-84	85-96
1	0.03836	4.8997	0.1865	0.67296	99.34	94.073	0.46987	0.35408
6	0.96614	5.1224	0.71883	1.8145	95.731	92.027	2.5841	1.0363
12	0.96812	5.1309	0.7206	1.8157	95.723	92.017	2.5878	1.0365
18	0.96813	5.1313	0.7206	1.8157	95.723	92.016	2.5878	1.0365
24	0.96813	5.1313	0.7206	1.8157	95.723	92.016	2.5878	1.0365

Table 6.27: Forecast Error Variance Decomposition of P in Percentage at 24-month Horizon (1970-1996)

Horizon	BC	M1	Y	P
1	0.5505	0.9453	0.3295	99.521
6	2.1996	0.9643	1.0115	95.825
12	2.2331	0.97175	1.0345	95.761
18	2.2338	0.97187	1.0346	95.76
24	2.2338	0.97188	1.0346	95.76

Table 6.28: Forecast Error Variance Decomposition of P in Percentage at 24-month Horizon (1970-1984) and (1985-1996)

Horizon	BC		M1		Y		P	
	70-84	85-96	70-84	85-96	70-84	85-96	70-84	85-96
1	0.13205	0.77851	0.37905	1.0558	0.32693	2.8603	99.162	95.305
6	2.309	0.85287	1.2494	1.2038	0.6263	3.0906	95.815	94.853
12	2.3172	0.86044	1.2493	1.204	0.6295	3.0908	95.804	94.845
18	2.3172	0.86066	1.2493	1.204	0.62951	3.0908	95.804	94.845
24	2.23172	0.86067	1.2493	1.204	0.62951	3.0908	95.804	94.845

broader aggregate (such as M2). As a result, M1 is commonly believed to correspond to movements in spending, rather than interest rate induced asset shifts. Should random portfolio shifts across monetary aggregates become more common, they could limit the information value of M1 movements, and make M1 less reliable as a guide to policy (Blundell-Wignall and Gizycki, 1992).

Though financial deregulation has undermined banks' position as providers of "money", it has not affected banks' position as providers of credit for small borrowers who find it difficult to borrow directly in open markets. As shown in Table 3.1 (Chapter Three), despite losing large corporate clients to non-bank institutions, such as the equity market and the debt instruments market, the commercial banks are still the main lending institutions for small and some medium-sized firms, traditionally dependent on banks for financing.

Figures 6.5 and 6.6 illustrate the impulse responses of Y and P to one-standard deviation shocks from BC and M1 disturbances. Figure 6.5 shows that there appears to be a similar pattern of dynamic response of Y to BC and M1. Y begins to return to its baseline path in about twelve months. However, there appears to be an opposite pattern of dynamic response of P to BC and M1. Figure 6.6 shows that the response of P to BC looks much like a mirror reflection of the response of P to M1. However, in either case P returns to its baseline level in around twelve months.

In the VAR analysis, it is also interesting to examine the causal link between the variables under study. As described in Chapter Five, a test of causality centres on

Figure 6.5: Orthogonalized Impulse Response of Y to One SE Shock to BC and M1

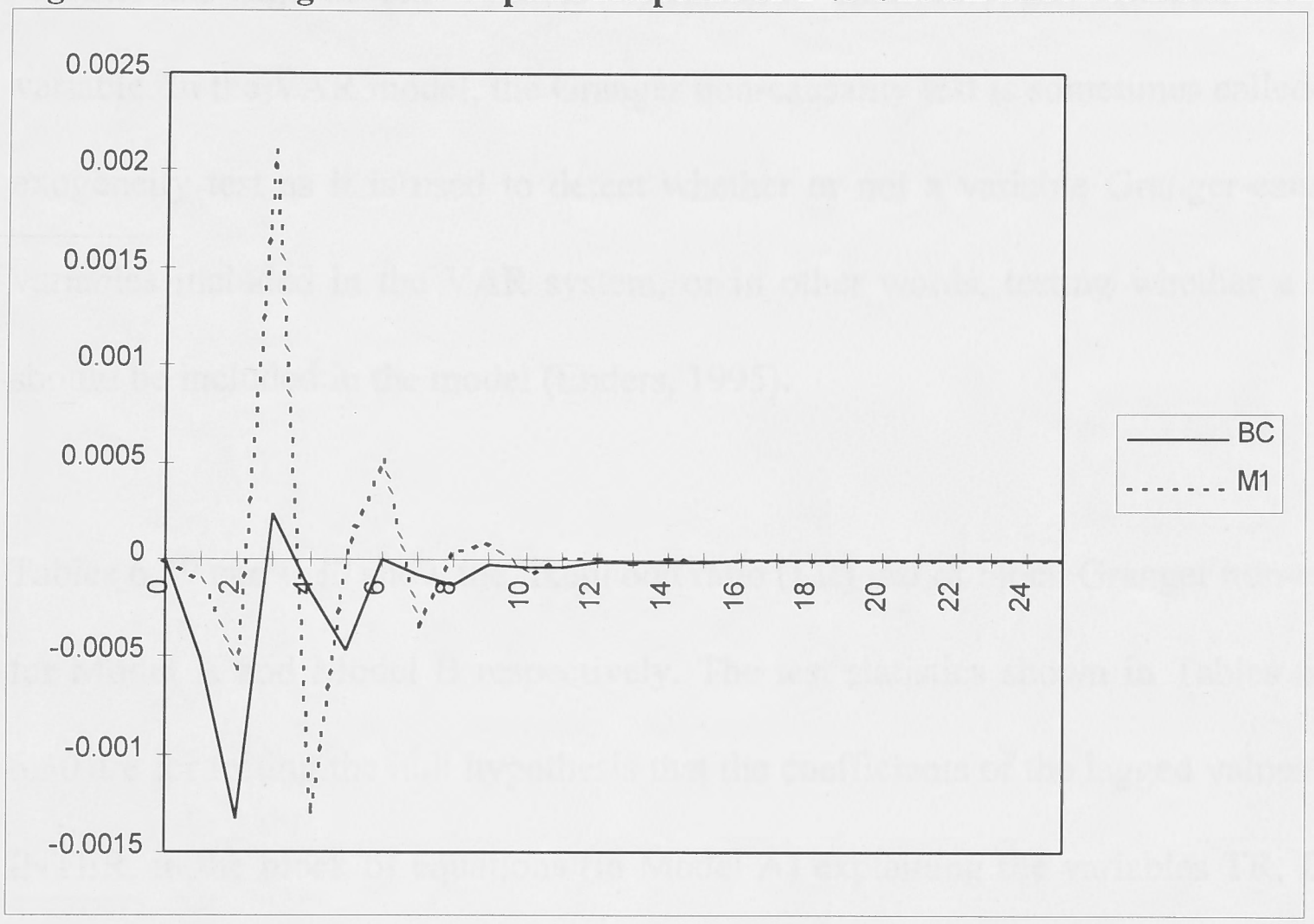
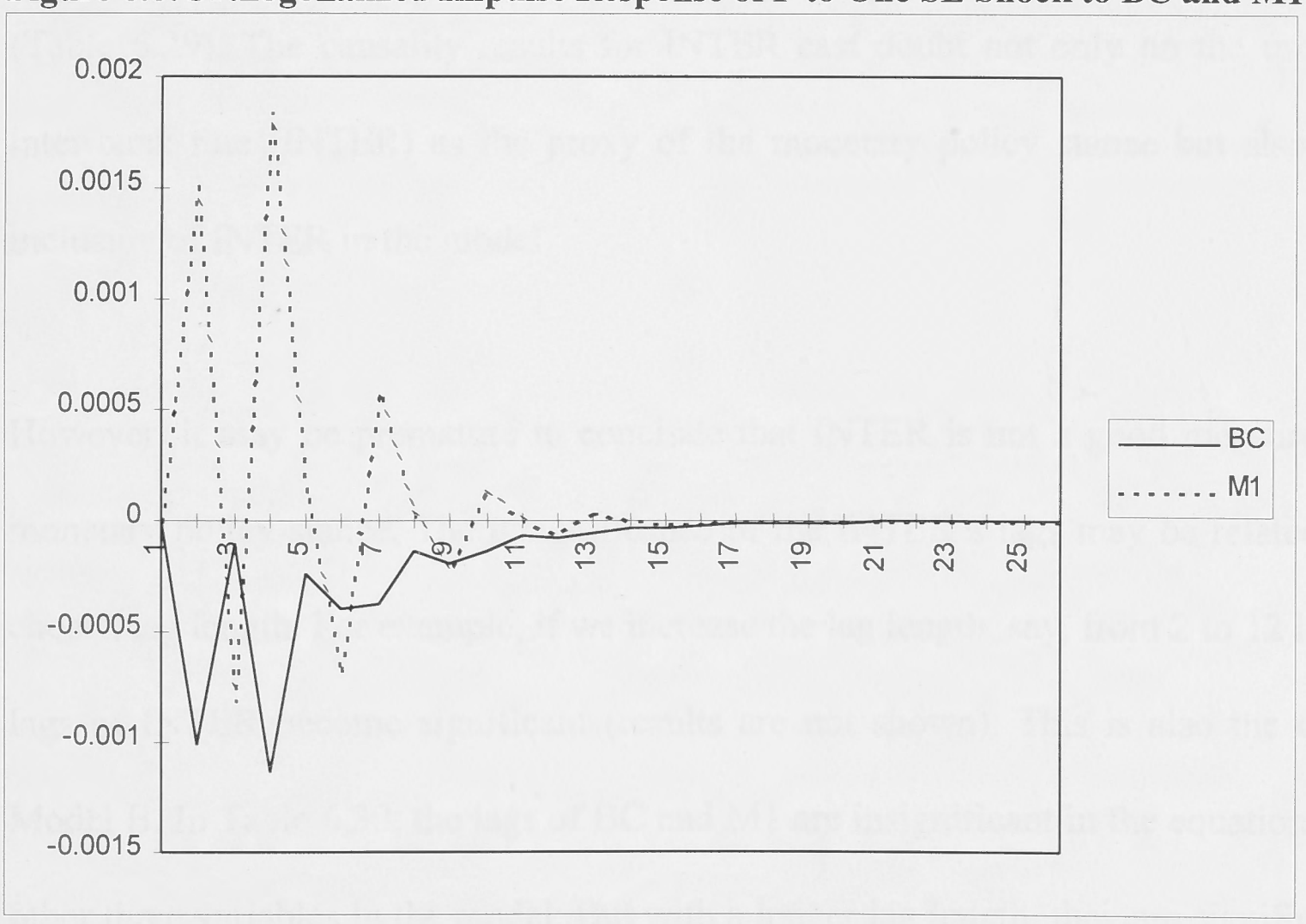


Figure 6.6:Orthogonalized Impulse Response of P to One SE Shock to BC and M1



whether the lags of one variable significantly enter into the equation for another variable. In the VAR model, the Granger non-causality test is sometimes called a block exogeneity test as it is used to detect whether or not a variable Granger-cause other variables included in the VAR system, or in other words, testing whether a variable should be included in the model (Enders, 1995).

Tables 6.29 and 6.30 show the likelihood ratio (LR) test of block Granger non-causality for Model A and Model B respectively. The test statistics shown in Tables 6.29 and 6.30 are for testing the null hypothesis that the coefficients of the lagged values of, say, INTER, in the block of equations (in Model A) explaining the variables TR, DD, and BC are zero. In Model A, the lags of INTER in TR, DD, and BC equations are statistically insignificant, whereas the lags of the other three variables are significant (Table 6.29). The causality results for INTER cast doubt not only on the use of the inter-bank rate (INTER) as the proxy of the monetary policy stance but also on the inclusion of INTER in the model.

However, it may be premature to conclude that INTER is not a good measure of the monetary policy stance. The insignificance of the INTER's lags may be related to the chosen lag length. For example, if we increase the lag length, say, from 2 to 12 lags, the lags of INTER become significant (results are not shown). This is also the case for Model B. In Table 6.30, the lags of BC and M1 are insignificant in the equations of the other three variables in the model. But with a longer lag length, they are significant. To comply with a conventional VAR estimating procedure, we choose

Table 6.29: Likelihood Ratio (LR) Test of Block Granger Causality (Model A)

	1970-1996	1970-1984	1985-1996
INTER	4.57	5.02	1.91
	(0.6)	(0.541)	(0.928)
TR	22.39	9.44	14.57
	(0.001)	(0.150)	(0.024)
DD	18.42	21.33	8.53
	(0.005)	(0.002)	(0.202)
BC	15.96	14.71	12.53
	(0.014)	(0.023)	(0.051)

Numbers in parenthesis are marginal significance levels

Table 6.30: Likelihood Ratio (LR) Test of Block Granger Causality (Model B)

	1970-1996	1970-1984	1985-1996
BC	13.05	7.39	5.97
	(0.16)	(0.286)	(0.426)
M1	9.86	3.85	8.13
	(0.362)	(0.696)	(0.229)
Y	12.41	5.34	15.89
	(0.192)	(0.501)	(0.014)
P	20.36	12.6205	1.41
	(0.016)	(0.049)	(0.965)

Numbers in parenthesis are marginal significance levels

not to deliberately increase the lag length just to render the lags of some variables significant, but stick with the initial lag length suggested by AIC and SBC.

In Chapter Five, we have admitted that our empirical approach using M1 as a measure of the conventional money channel and bank credit as a measure of the lending channel may suffer an "identification" problem. Both M1 and bank credit are actually components on both sides of bank balance sheets. Commercial banks create money every time they expand the aggregate volume of bank loans outstanding in the economy. In addition, it is difficult to identify the existence of the lending channel by just examining the relationship between bank credit and output. For example, a decline in output may, in fact, be attributable to the conventional money channel. The fall in the quantity of loans may simply reflect a decline in the loan demand due to reduced output (through the conventional money channel), not a reduction in the loan supply (Keshyap, Stein, and Wilcox, 1993).

Difficulties in identifying the existence of the bank lending channel remind us of the controversy of whether the lending channel is an independent channel or merely a supplementing channel to the conventional money channel. As pointed out in Chapter Four, some advocates of the lending channel believe that the lending channel is merely an enhancement mechanism, not a truly independent channel, whereas some other believe otherwise.

The crux of this conflicting view may stem from the way in which monetary policy is implemented. If monetary policy is carried out through conventional open market

operations, then it is likely that the lending channel may only be an enhancement mechanism. Monetary tightening through open market sales of government bonds ensues a contraction of both money (deposits) on the liability side of banks' balance sheet and credit on the asset side of banks' balance sheet. The lending view tries to highlight that a fall in banks' assets should also be considered potentially important as in the case of a fall in banks' liabilities.

In the conventional money view, a fall in bank loans does not matter as firms can supposedly maintain their investment and spending by borrowing elsewhere. The lending view disagrees and argues that due to the existence of imperfect information in the capital market, there are a large number of firms who cannot borrow in open markets and have to rely on banks for financing. The lending view believes that a distinct recognition of bank loans in monetary policy transmission will provide a more complete explanation of monetary policy transmission.

As far as the mechanism of monetary policy is concerned, the lending channel can only operate independently of the conventional money channel, if monetary policy is in the form of direct credit actions, such as, credit ceilings. Direct credit actions allow the central bank to affect the loan supply more directly without going through the traditional reserve mechanism as in the case of open market operations. In this special case, only the asset side of the bank sheet is targeted.

In the real world, direct credit actions are often used in conjunction with conventional monetary policy methods, such as, open market operations. In this case, the direct

lending channel through the direct credit actions should help strengthen the impact of the conventional money channel (one which emanates from the effect of monetary tightening on the liability side of the bank balance sheet) and the indirect lending channel (one which stems from the effect of monetary tightening on the asset side of the bank balance sheet).

If monetary policy is carried out solely through direct credit actions, then the lending channel should become an independent channel with an independent effect in the sense that this effect is driven primarily by a credit crunch. However, if monetary policy is implemented by a combination of direct methods (credit controls) and indirect methods (open market operations), the lending channel and the conventional money channel should reinforce each other.

6.5. Narrative Approach

One of the best ways to identify the effect of a credit crunch caused by direct credit actions is to delve into a historical record. This historical approach is advocated by Romer and Romer (1989) who contend that purely statistical tests may not always be the best way to study the real effects of monetary shocks. Instead, they propose a "narrative" approach to identify whether or not monetary policy disturbances matter. Romer and Romer's narrative approach, which they have applied to the U.S, basically involves studying a historical record to identify monetary shocks, defined as periods when concerns about the current level of inflation prompted the Federal Reserve Bank to take actions to induce a decline in output growth.

Romer and Romer (1993) note that in most episodes in which tight monetary policy was found to lead to recession, monetary policy had a large impact only when open-market operations were supplemented by actions or regulations aimed directly at restricting bank lending. Without such direct actions and regulations, banks would have had sufficient flexibility in their portfolios and in their ability to raise funds to avoid sharp reductions in their lending. Romer and Romer, like many other advocates of the lending view, believe that through the lending channel, monetary policy can have an impact over and beyond changes in the general level of interest rates. However, unlike other lending-view proponents, Romer and Romer (1993) find that the main effect of the lending channel comes from direct credit actions.

To see the impact of monetary policy operating through the (direct) lending channel, we will use the narrative approach for two purposes. One is to identify the period when the Bank of Thailand opted to use direct policy actions to bring down the loan supply more directly. The other is to study the impact of the direct credit actions.

Delving into the Bank of Thailand's annual and quarterly reports, we found that there was one episode in 1984 when the Bank of Thailand clearly took unprecedented drastic actions to bring down the loan supply to achieve its monetary policy goals. Traditionally, controlling inflation and promoting a short-term stabilisation of income growth and external balance are the Bank of Thailand's principal monetary policy goals (Warr and Nidhiprabha, 1996).

A current account deficit of over 7% of GDP in 1983 prompted the Bank of Thailand to tighten monetary policy to rein in excessive external imbalance. Table 6.31 shows that the current account deficit in 1983, about B$ 66.3 billion, was the worse during the 1980s. The balance of payments in 1983 was in the red for the first time in the 1980s. As shown in Figure 6.7, there was a sign of excessive lending by the banks; bank credit growth rate surged to over 32.4% in 1983.

In response to the worsening external balance and the exuberant growth of bank lending, the Bank of Thailand imposed an unprecedented credit ceiling of 18 % in January 1984. The banks were instructed to cap their credit growth at 18% of loans outstanding at the end of 1983. In Figure 6.7, it can be seen that credit growth rate was drastically reduced from 32.4 % in 1983 to 18.1% in 1984. The loan interest rate ceiling was also lifted from 19% to 21%. Other key interest rates, such as the discount and the inter-bank rates were also driven up (see Figure 5.1 in Chapter Five).

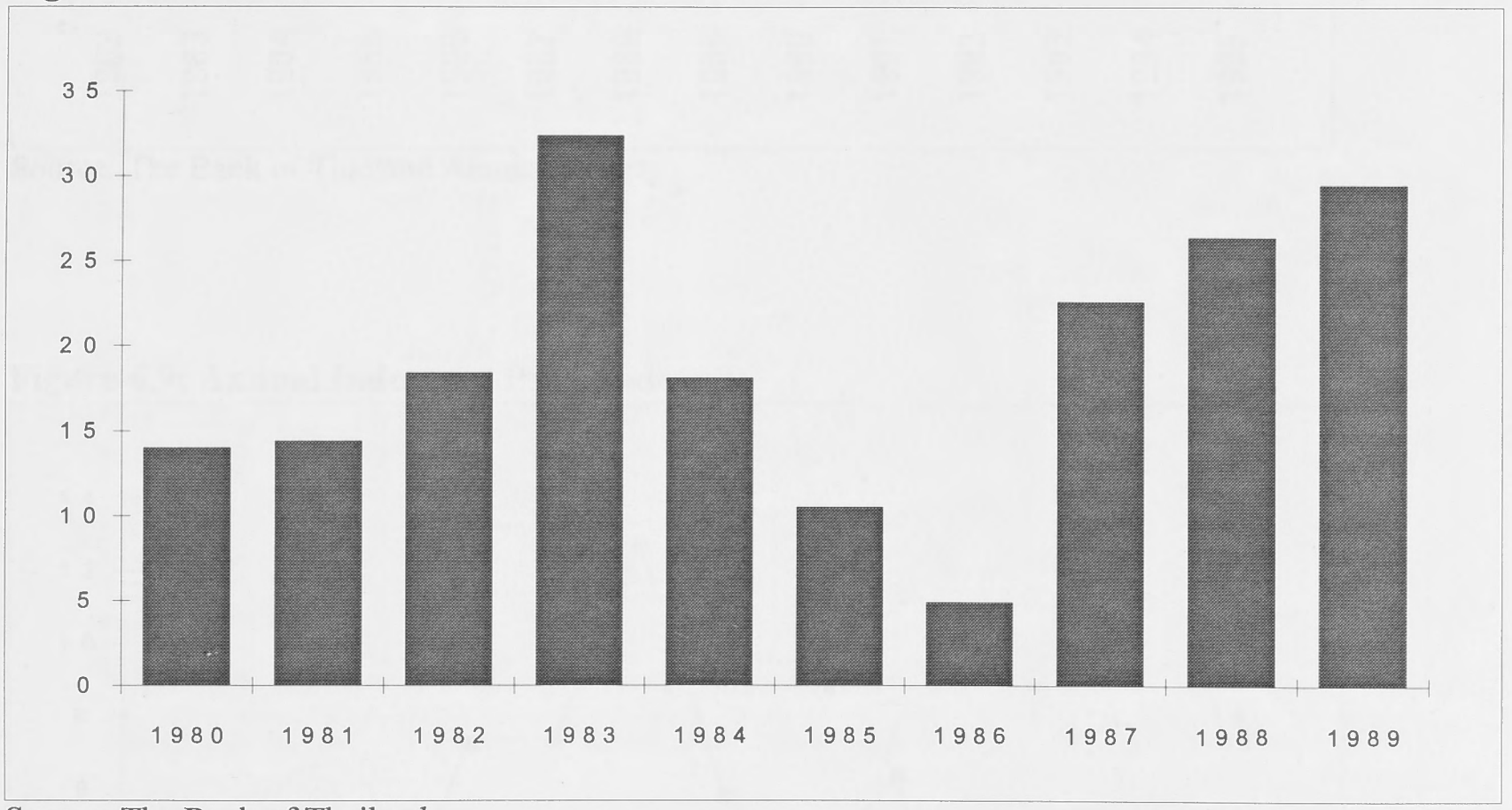
A drastic credit control in 1984 led to a "credit crunch" and caused considerable difficulty to the business sector and a sharp slow-down in the country's economic growth. In the short and medium term, economic hardship was reflected in a record number of unhonoured checks during February to March 1984 and a sharp fall in the investment index (Bangkok Bank Review, 1984). The monetary tightening successfully brought down the current account deficit from 7.30 % of GDP in 1983 to 4.1% in 1985, followed by a small surplus in 1986. The rate of inflation fell sharply to a historic level of 0.8% in 1984 (Figure 6.8). The rate of inflation of industrial price index tumbled to below 0% (Figure 6.9).

Table 6.31: Current Account and Balance of Payments

Year	Current Account Balance		Balance of Payments	
	in billion baht	in % of GDP	in billion baht	in % of GDP
1980	-48.4	-6.4	5.2	0.26
1981	-54.7	-7.4	2.5	0.08
1982	-25.6	-2.8	3.3	0.14
1983	-66.3	-7.3	-18.1	-0.79
1984	-49.5	-5.1	10.6	0.4
1985	-41.9	-4.1	12.5	0.5
1986	6.5	0.6	33.6	1.3
1987	-9.3	-0.7	18.2	0.7
1988	-41.8	-2.8	40.5	1.6
1989	-65.4	-3.7	111.5	4.3

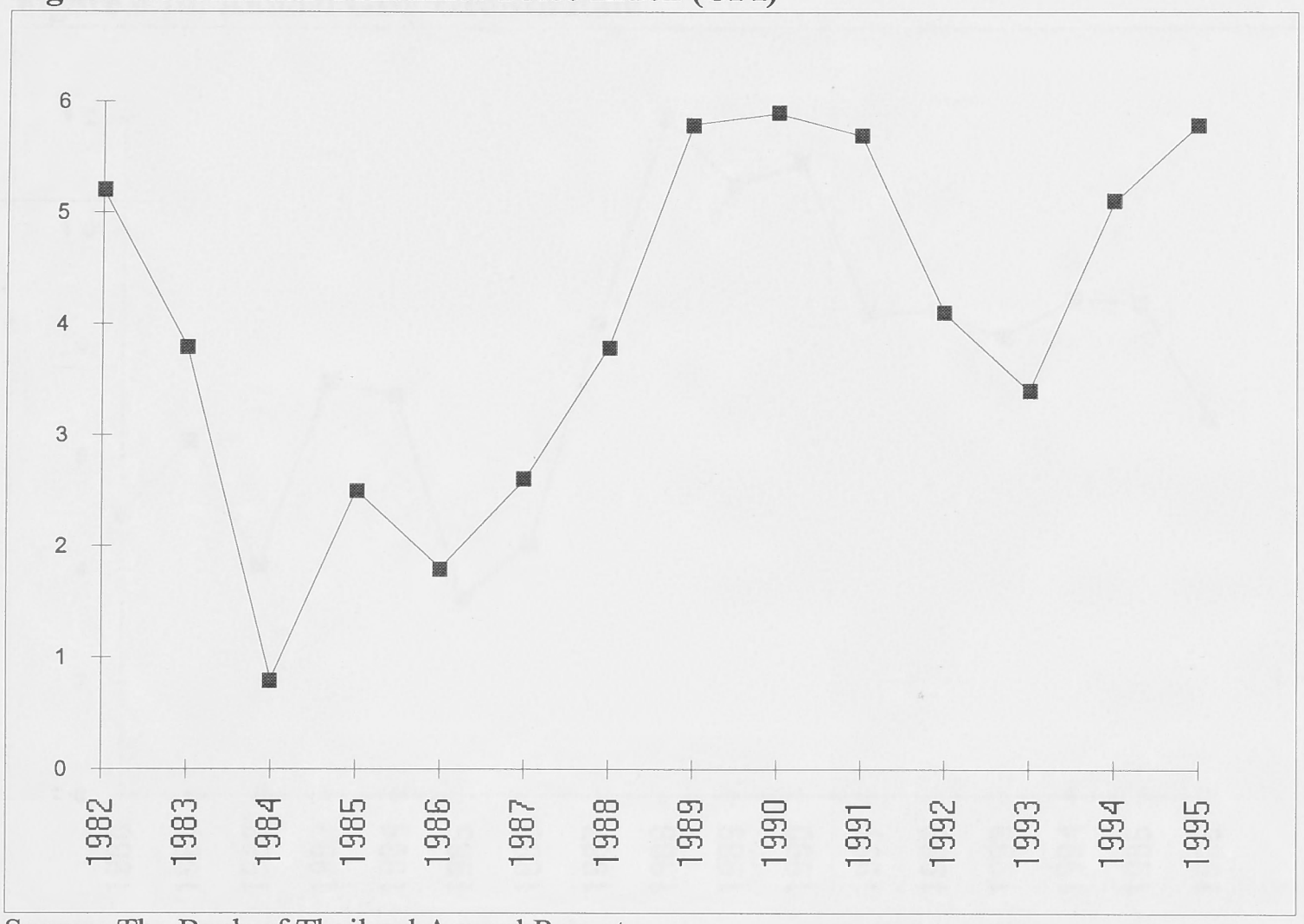
Source: The Bank of Thailand Annual Report

Figure 6.7: Growth Rate of Bank Credit to Private Sector



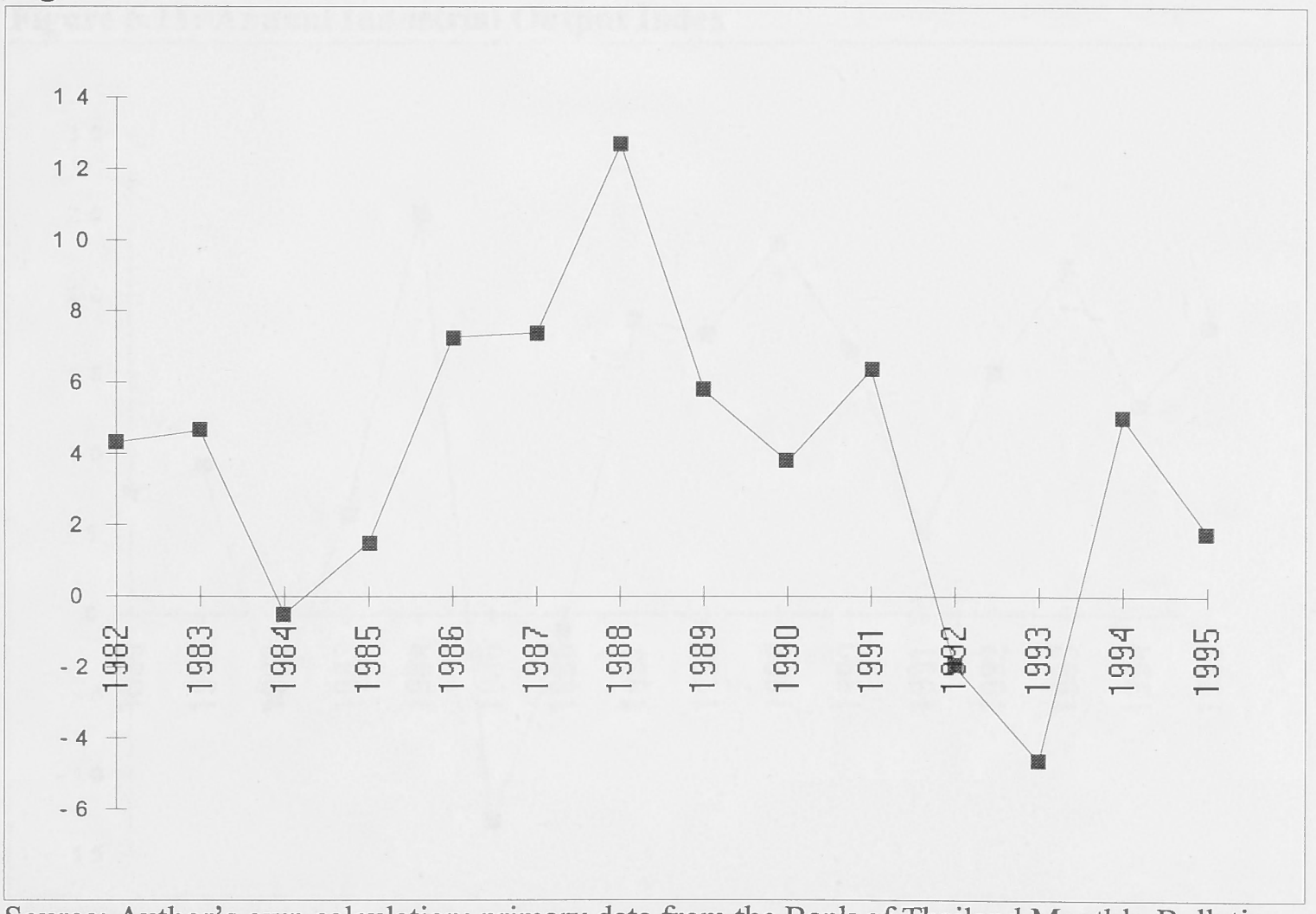
Source: The Bank of Thailand

Figure 6.8: Annual Consumer Price Index (CPI)



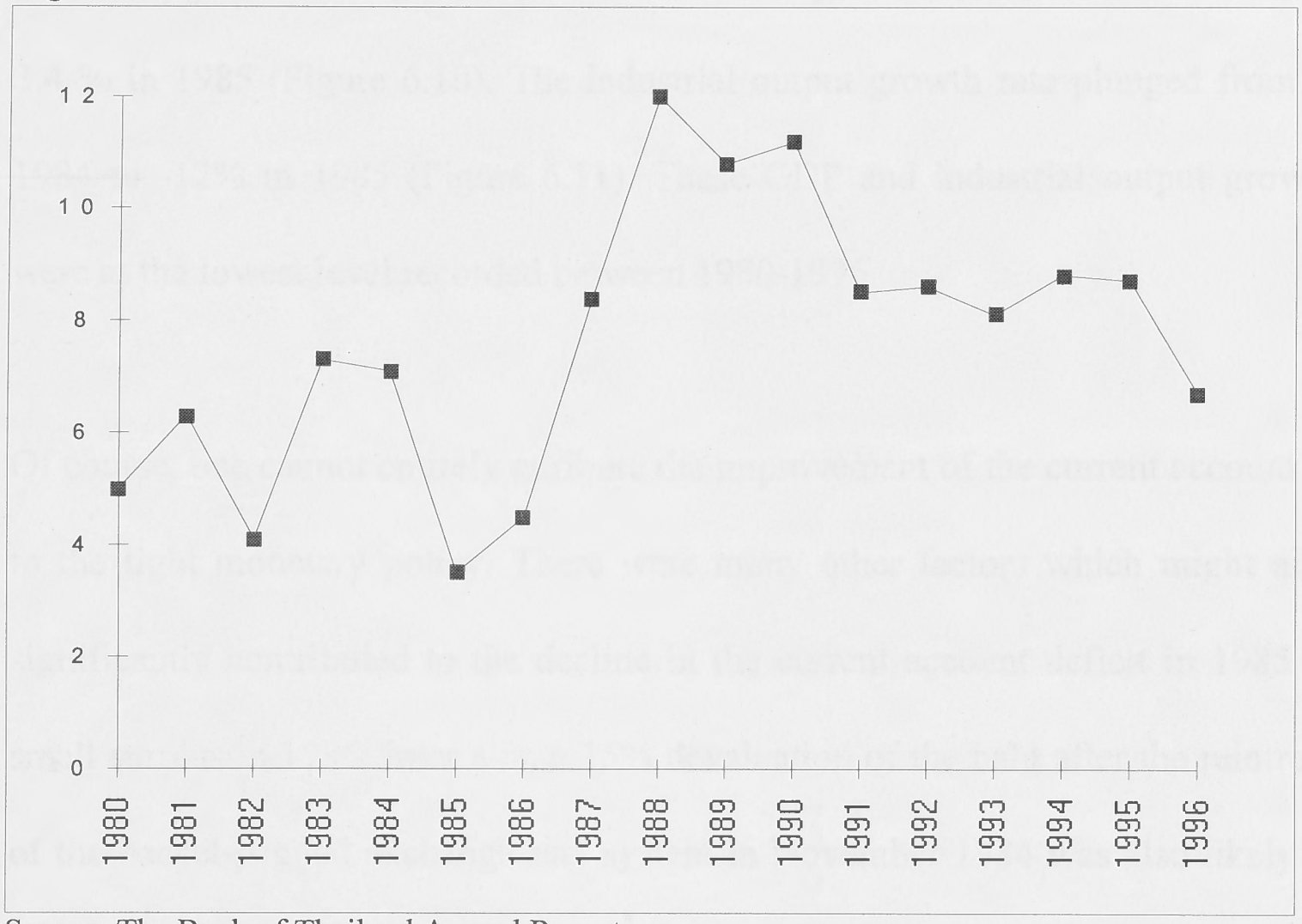
Source: The Bank of Thailand Annual Report

Figure 6.9: Annual Industrial Price Index



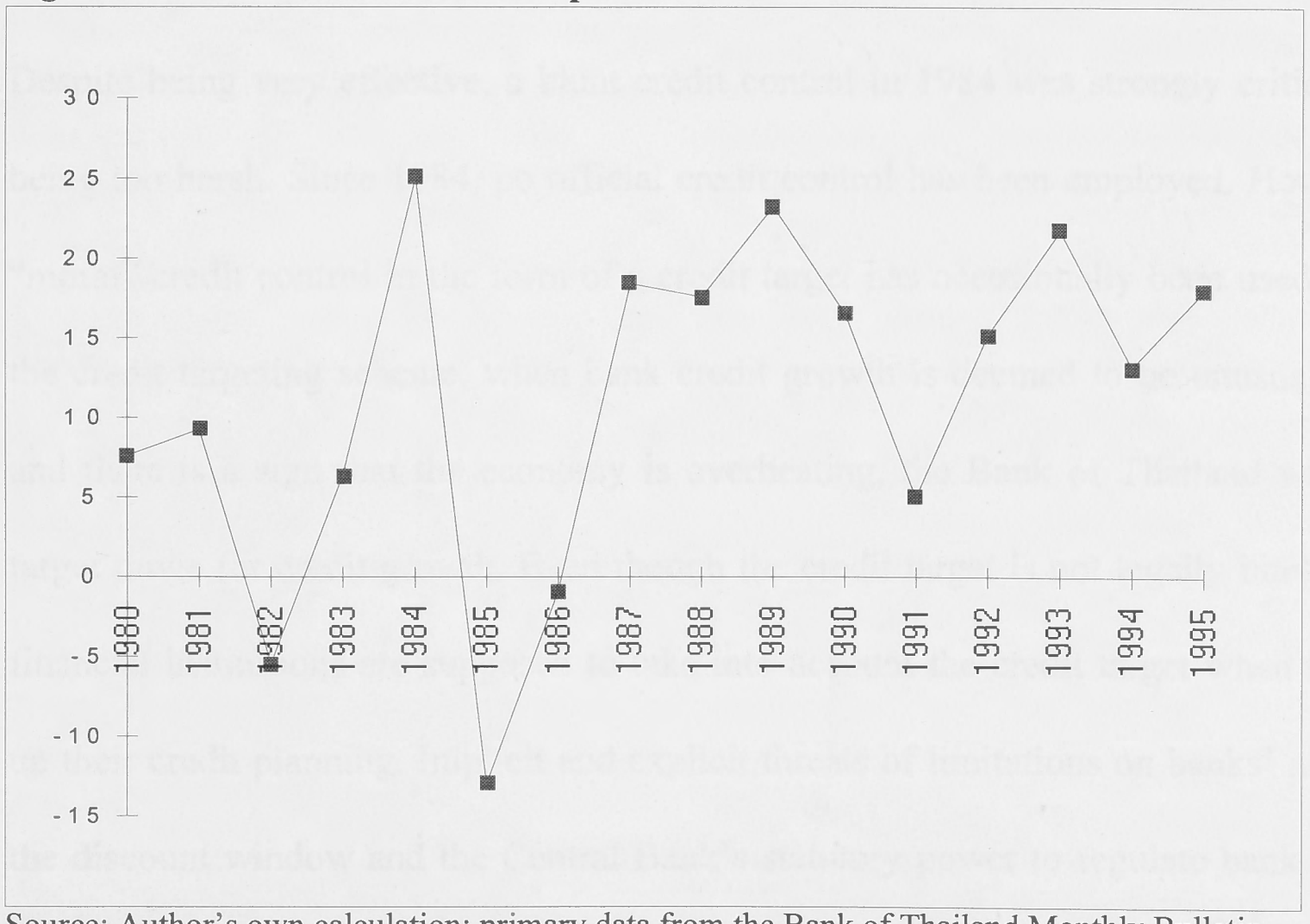
Source: Author's own calculation; primary data from the Bank of Thailand Monthly Bulletin

Figure 6.10: Annual GDP Growth Rate



Source: The Bank of Thailand Annual Report

Figure 6.11: Annual Industrial Output Index



Source: Author's own calculation; primary data from the Bank of Thailand Monthly Bulletin

However, the improved external balance came at a very high price, as the country's economic growth had to be sacrificed. The GDP growth rate fell from 7.3% in 1983 to 3.4 % in 1985 (Figure 6.10). The industrial output growth rate plunged from 25% in 1984 to -12% in 1985 (Figure 6.11). These GDP and industrial output growth rates were at the lowest level recorded between 1980-1996.

Of course, one cannot entirely attribute the improvement of the current account balance to the tight monetary policy. There were many other factors which might also have significantly contributed to the decline in the current account deficit in 1985 and the small surplus in 1986. Inter alia, a 15% devaluation of the baht after the reintroduction of the basket-pegged exchange rate system in November 1984 was also likely to have been one of the main contributing factors to the improvement of the current account balance and the economic growth in 1986.

Despite being very effective, a blunt credit control in 1984 was strongly criticized as being too harsh. Since 1984, no official credit control has been employed. However, a "moral" credit control in the form of a credit target has occasionally been used. Under the credit targeting scheme, when bank credit growth is deemed to be unusually high and there is a sign that the economy is overheating, the Bank of Thailand will set a target range for credit growth. Even though the credit target is not legally binding, the financial institutions are supposed to take into account the credit target when they set up their credit planning. Implicit and explicit threats of limitations on banks' access to the discount window and the Central Bank's statutory power to regulate bank lending

activity, and to alter existing reserve requirements or impose new ones ensure the Central Bank enough leverage to implement its policy.

Direct credit actions when used in conjunction with a conventional monetary policy, typically involving the Central Bank's attempt to influence the cost and the availability of bank reserves, could significantly enhance the effectiveness of monetary policy. However, as mentioned in Chapter Four, direct credit actions, such as, credit ceilings, make it difficult for certain borrowers to obtain loans, or force particular borrowers to pay a premium for funds that is not justified by difference in risk. Certain borrowers are dissuaded from undertaking investment simply because of a lack of funds. Hence, direct credit actions may only create inefficiency in the provision of credit (Romer and Romer, 1993).

Moreover, with the advent of the world-wide trend towards global financial liberalization, direct credit actions may become obsolete, ineffective, and undesirable. As commonly found in many countries, including Thailand, financial deregulation and innovation make it easier for potential borrowers to obtain funds from various sources. In Thailand, since the late 1980s the financial market has become much more diversified and sophisticated. The commercial banks, though still the main lending institutions, have experienced increasing competition from domestic and foreign financial institutions and also from non-bank institutions.

With greater diversification and sophistication of the domestic financial market, there has been a call for a "widening" of monetary policy from being largely bank-oriented to

more market-oriented. The development of the (private) bond market and the adoption of a flexible exchange rate system should enable the Bank of Thailand to conduct its monetary policy more effectively through a conventional market-based mechanism, such as, open market operations.

Chapter Two explained that apart from being a source for mobilizing long-term funds, the bond market can also provide different kinds of market-based monetary policy instruments to substitute for direct instruments which tend to be ineffective in a liberalized financial system. Given the demand for the central bank's liabilities in the forms of bank notes and reserve deposits held by banks for clearing purposes or meeting reserve requirements, the central bank can manipulate the cost and supply of reserves by buying and selling bonds and others money market instruments. This will, in turn, indirectly affect the availability of credit and interest rates. This kind of indirect mechanism will only work if there is a well-functioning market for bonds and short-term commercial paper.

6.6. Conclusion

This chapter undertakes two empirical tests: one on the transmission of monetary policy through the lending channel (Model A) and the other on the forecasting power of money and credit shocks (Model B). In Model A, the impulse response function illustrates that monetary policy shocks result in a short-run rise in the inter-bank rate, a fall in reserves. Bank loans and deposits are found to increase, rather than decrease. A "perverse" short-term behaviour of loans may arise from the fact that as sales and cash flows fall at the beginning of a downturn, firms may demand more credit. A pre-

arranged line of credit can make it difficult for banks to cut the loan supply. As discussed in the theoretical model, by running down their reserves or resorting to a liability management technique, banks may be able to maintain or perhaps even increase their supply of loans in the short run.

In Model B, the variance decomposition shows that bank credit appears to fare better than M1 in explaining the future error variance of output and price measures. The poor performance of M1 may be attributable to financial liberalization and innovation which may have undermined a close relationship between M1 and a measure of economic activity (Y).

A narrative approach is employed to study the impact of monetary tightening, especially through direct credit actions. One episode in 1984 was identified as a period in which the Bank of Thailand clearly took a drastic action to bring down the loan supply by imposing an 18% credit ceiling. The 1984 credit crunch led to drastic impacts on the economy. It brought down the current account deficit, inflation, and economic growth.

Chapter Seven

Conclusion

This dissertation has analyzed the transmission of monetary policy through the bank lending channel. The objective of this thesis is twofold: first, to develop a simple theoretical model for understanding the lending view; and second, to undertake an empirical analysis of the lending channel. In the literature, little work has been done on the theoretical modelling of the lending view, even though there has been a resurgence of interest in the lending view in recent years. Most studies on the lending view tend to concentrate on empirical testing. To address the imbalance in the analysis of the lending view, this thesis attempts to study the lending view both theoretically and empirically. In addition, unlike other studies in the literature which are largely drawn from U.S. experience and data, this study applies the theory of the lending view to Thailand, an emerging developing country.

As described in Chapter Two, Thailand's financial market has undergone major changes in recent years. The financial market has long been dominated by the commercial banks. The banks' dominant role in the financial market can be attributable, in part, to their special expertise in alleviating the imperfect information in the capital market, and, in part, to the under-development of the capital market in Thailand. However, during the past decade, the capital market has become more diversified and sophisticated. The stock market and the debt instrument market have grown rapidly since the mid 1980s. The banks, though still major institutions, have seen their dominance in the financial market, particularly in the capital market, gradually eroded.

To examine the importance of bank lending in monetary policy transmission in the light of structural changes in the financial market, this thesis began by providing an overview of Thailand's financial market, recent financial development, and monetary policy procedure. According to Kashyap and Stein (1993), the lending channel is likely to be sensitive to a number of institutional characteristics of the financial market. As described in Chapter Two, Thailand's financial market can be divided into two distinctive markets: the money market and the capital market. Prior to the mid 1980s, the distinction between the two markets was blurred, as the commercial banks in the absence of active equity and bond markets were by far the most dominant lending institutions in both money and capital markets.

Given the institutional characteristics of the financial market, Thailand's monetary policy has traditionally been conducted via three major mechanisms: the discount window facility; the repurchase market; and the Exchange Equalization Fund (EEF). Through these mechanisms, the Central Bank exerts its influence over the supply of money and credit; domestic interest rates; and in some cases the value of the currency. However, in reality the BOT's influence over bank lending activity through the three mechanisms is rather limited. The discount window facility is a relatively minor source of reserves for the banks. After the flotation of the baht in July, 1997, the role of the EEF in influencing bank liquidity is likely to reduce.

The BOT's ability to influence the cost and supply of bank reserves through the repurchase market is hampered by the current arrangement in the market which only allows the BOT to intervene in the market when there is an imbalance of bids and offers

outstanding. Self-initiated operations are not applicable within the existing arrangement. In recent years, the BOT has been very active in nurturing the bond market as a vehicle for conducting monetary policy. A well-functioning bond market is typically one of the prerequisites for effective open market operations.

In the theoretical model, it is argued that if monetary policy is conducted through conventional open market operations, the lending channel is likely to play a supplementing role, rather than an independent role to the conventional money channel. However, if the central bank is prepared to cause a "credit crunch" by bringing down the supply of loans more directly, say, through direct credit actions, then it is possible that the lending channel can operate independently.

To understand the operation of the lending channel, the distinction between the lending channel and the conventional money, and the conditions necessary for the existence of the lending channel, a simple model was developed by modifying the traditional IS-LM model. The loan market was introduced and then incorporated with the goods market. The incorporation of the goods market and the loan market resulted in the creation of the CC (credit and commodity market) curve, and the CC-LM model as an alternative to the conventional IS-LM model. By exploiting the principle of bank profit maximization, the theoretical model was then further expanded to analyze the conditions required for the existence and effectiveness of the lending channel. The existence and effectiveness of the lending channel were found to be critically dependent on how banks respond to monetary tightening.

To examine the importance of the lending channel in Thailand's monetary policy, the SVAR technique was employed. The empirical analysis focused on two key issues: testing the transmission of monetary policy through the lending channel (Model A) and testing the forecasting power of money and credit shocks (Model B). In Model A, the inter-bank interest rate was chosen as a measure of monetary policy shock. Monetary tightening (a positive innovation in the inter-bank rate) is expected to result in a reduction in bank reserves, which should be followed by a decline in bank loans and deposits. However, in the short run loans might not fall immediately and could possibly even rise. But over time it is expected that loans will eventually fall.

In Chapter Six, impulse response function results illustrated that bank reserves fall after a tightening of monetary policy, while deposits and loans increase. Bernanke and Blinder (1990) suggest that a plausible explanation for a "perverse" short-term behaviour of loans may arise from the fact that as sales and cash flows fall at the beginning of a downturn, firms may demand more bank credit in order to finance inventories and payrolls. A pre-arranged line of credit may also make it difficult for banks to cut their loan supply unilaterally. In addition, by running down their reserves or resorting to a liability management technique, it is not impossible for banks to maintain or perhaps even increase their supply of loans in the short run.

Model B dealt with testing the forecasting power of bank credit and narrow money supply M1. The SVAR results showed that bank credit appears to out-perform M1 in explaining the future error variance of output (Y) and price (P), especially during 1985-1996. These results suggest that even if the commercial banks have gradually lost their

dominant role in the financial market in recent years, they are still an important source of financing. Anything which disrupts normal banking activity is likely to have real impacts. Financial liberalization and recent changes in the financial structure do not seem to have diminished the role of bank lending, at least up to the period covered in this study.

Nonetheless, as pointed out in Chapter Six, these empirical results should be taken with some caution. A poor performance of M1 could be attributable to financial liberalization and innovation. It is also admitted that our empirical approach using M1 as a measure of the conventional money channel and bank credit as a measure of the lending channel may suffer an "identification" problem. Both M1 and bank credit are, in fact, components on both sides of bank balance sheets. Commercial banks create money every time they expand the aggregate volume of bank loans outstanding in the economy.

Moreover, it is difficult to identify the existence of the lending channel by just looking at the relationship between bank credit and output. In the literature, many empirical approaches have been proposed to test the existence of the lending channel. The most notable one is Kashyap, Stein, and Wilcox (1993) (KSW). Although the KSW approach is appealing, it is not replicated in this study due to a lack of data.

Limitations of the study and suggestions for future research

Since there are not many works on the theoretical modeling of the lending view, our theoretical model was inspired significantly by the work of Bernanke and Blinder (1988). Admittedly, our theoretical model may be rather too simple to analyze the lending view more comprehensively. However, given that in the literature there are few works on the theoretical modeling of the lending view, we hope that our theoretical model could serve as a stepping stone for anyone interested in the lending view to further develop a more advanced model.

Applying the theory of the lending view to a developing country like Thailand, we faced difficulties in obtaining some data needed for the empirical analysis. The availability of the data plays an important role in shaping the course of our empirical analysis. Had we been able to obtain more data, we would have expanded our theoretical and empirical analysis to cover some other related interesting issues, such as analyzing the disproprotional impacts of monetary policy on banks and firms with different size. It can be expected that smaller banks and firms are likely to be affected proportionately more than larger ones. We hope that as more data become readily available in the future, issues left unaddressed in this study can be analyzed.

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Appendix I

Financial Instruments and International Financial Markets

Financial Instruments

Bill of Exchange

A bill of exchange is a short-term instrument in the form of a document ordering the drawee (the debtor) to pay the drawer (the creditor) a stated sum at a specific date or "at sight" (on demand). Once accepted, i.e. signed by the drawee and "endorsed"(signed on the back) by the drawer, the bill becomes negotiable and may be discounted, i.e. sold at discount on its face value. A bill of exchange normally has a maturity of up to six months.

Certificates of Deposit (CDs)

A document issued by a bank acknowledging a deposit of money with it, and considering a promise to repay that sum, to the bearer, at a specific future date. Certificates of deposit are "negotiable", i.e, they may be transferred by simple delivery. To ensure the marketability of the certificates, there needs to be a "secondary market", a place where the holder of the certificates can sell then if he or she wishes. The secondary markets make the certificates highly liquid for the holder while securing the funds to the bank for a fixed period. Interest rate is paid on the certificates annually, if the term to maturity is longer than a year, or at maturity, if less.

Commercial Paper

Commercial paper is a term for unsecured promissory notes generally issued by large corporations. Commercial paper represents a major source of short-term funds for corporations, especially those with a well-established reputation. Most commercial paper carries an initial maturity of sixty days or less and can be regarded as a close substitute for Treasury Bills, certificates of deposits and other money market instruments. Because of its relatively low risk and short maturity, investors in commercial paper tend to be large institutions, such as, insurance companies.

Debentures

Debentures are debt securities carrying a fixed rate of interest, usually issued by a company and secured on its assets. A debenture holder is a creditor of the company, and is entitled to be paid the interest regardless of whether or not the company makes profits, and before any distribution of dividends.

Eurobonds

Eurobonds are bonds denominated in currencies other than that of the country in which the bond is sold. For example, Thai corporations issue Japanese yen-denominated bonds and sell them in Singapore (Asian Eurobonds).

Floating Rate Notes (FRNs)

Floating rate notes are issued in Euromarkets and pay a floating interest, usually set at half a percent above the six-month LIBOR (London Interbank offered rate) with a stipulating minimum interest. The rate is adjusted at six-monthly intervals.

Eurocurrency

Eurodollars are simply dollars held in the form of time deposits in banks outside the United States; these banks, in turn, lend these deposits out at a profit. The prefix "Euro" can be used interchangeably with "external" and refers to funds that are intermediated outside the country of the currency in which the funds are denominated. For instance, Euro-baht or offshore baht is a baht-denominated paper in the form of bonds, exchange contracts, certificates of deposit and other types of collateral. These are taken out of the country to be traded in foreign countries. Issuers of papers are major corporations and financial institutions in Thailand and abroad. Euro-baht commercial paper has become popular as a new way to raise funds as it carries higher returns and less foreign exchange risk than some other options.

Currency Option

The currency option provides a right but not obligation to buy or sell a specific currency at a specific price at any time prior to a specific date. Since options give the right without obligation, it means that commercial users of the market are able to obtain insurance against an adverse movement in the exchange rate, while still retaining the opportunity to benefit from a favourable exchange movement. The maximum risk to the buyers of the option is the actual cost of the option (premium).

Interest Rate Option

The interest rate option includes caps, floors, and collars. Unlike swaps and futures, the seller of the cap undertakes, over an agreed period, to compensate the buyer of the cap whenever a reference interest rate for example LIBOR exceeds a pre-agreed maximum

interest rate (the cap rate). By the same token, this principle is applied to a **floor option**, the investor will be protected by the seller whenever the reference rate falls below a pre-agreed minimum rate. The buyer will exercise the option only if interest rate falls below the agreed level and reap the benefits of the rate is over agreed rate. A **collar Option** is the simultaneous purchase and sale of a cap and a floor or a zero cost collar option. With the collar option, the cost of buying the floor exactly matches the premium received from selling the cap.

Promissory Note

A promissory note is a written unconditional promise made by one person to another to pay on demand or at a fixed or determinable future time a certain sum of money to, or, to the order of, a specific person, or to a bearer.

Currency Swap

A currency swap is simply an agreement to exchange certain amounts of two currencies on the spot (immediately) and to reverse the transaction at an agreed-upon exchange rate at a specific time in the future. In the swap transaction, the most important number is the swap rate (the difference between the price at which a currency is brought and the price at which it is sold).

Interest Rate Swap

The interest rate swap is an exchange between two counter-parties of interest obligations (payment of interest) or receipts (investment income) in the same currency on an agreed amount of notational principle for an agreed period of time. The agreed

amount is called a notational principle because it is not a loan or investment; the principle amount is not initially exchanged or repaid at maturity. An exchange of interest obligations is called a liability swap, while an exchange of interest receipts is called an asset swap. Interest streams are exchanged according to predetermined rules and are based on the underlying notational principle amount

Liability Management

Liability management is a process which allows banks to move from passively accepting deposits to actively managing deposits. By raising funds through, e.g. issuing CDs, banks can raise wholesale deposits at market rates enabling them to tailor the inflow of deposits to match a seasonal demand for wholesale credit. A reserve requirement is a major regulation that could constrain the growth of CDs. Imposing a reserve requirement on CDs increases the cost of issuing CDs, while removing it decreases the cost, as banks will have the freedom to price CDs in line with the market short-term interest rates.

Securitization of loans

Securitization is the process of pooling and repackaging homogenous loans, which would otherwise be illiquid, into securities and selling them to a group of investors, who purchase a financial instrument evidencing the indebtedness without recourse to the original lender. Securitization generates funds for banks for further lending activities. Raising funds through this kind of marketable instrument is regarded as an asset sale, since the entire transaction takes place on the asset side of the balance sheet.

Appendix II

The Chronological Evolution of the Exchange Rate System in Thailand since the End of the Second World War

1945 to 1963: Multiple Exchange Rate System

After the end of the Second World War, economic difficulties and a serious shortage of foreign exchange forced the government to adopt a multiple exchange rate system.

1963 to 1972: Bretton Woods Par Value System

With economic recovery, the multiple exchange rate system was replaced by the par value system. Under this system (Bretton Woods System), the baht was pegged in terms of gold, and hence the US dollar at the rate of 20.80 baht per US dollar. The exchange Equalisation Fund (EEF) was established to handle the stabilisation of the exchange rate. For almost two decades, the parity of the baht was maintained.

1972 to 1978: Par Value System with Devaluation and Appreciation

A consequence of the 1967 sterling devaluation, the ensuing gold crisis, and the resultant US devaluation led to a 10% devaluation of the baht against the gold standard to maintain fixed parity with the US dollar. The baht was devalued again in 1973 by 10% as a result of the first oil shock in the early 1970s. These two devaluations were, however, followed by a small appreciation around 4% in response to a gradual appreciation of major European currencies which had depressed the value of the baht against the currencies of Thailand's major trading counterparts. After this appreciation, there was no variation of the baht until the collapse of the Bretton Woods System in 1978.

1978: Pegged to a Basket of Currencies

For a short period in 1978 after the abolition of the par value system, a system of pegging the baht to a basket of currencies was introduced. This system permitted a greater degree of flexibility in the exchange rate adjustment to reflect more accurate economic and monetary conditions and to conform with the global economic trend. The exchange rate was solely determined by the EFF until the daily fixing system was adopted in late 1978.

Late 1978 to 1981: Daily Fixing System

Under daily fixing regime, the EFF and delegates from the commercial banks jointly determined the dollar exchange rate in tandem with the demand and supply of the US dollar in the market. The rates for six other major currencies were determined by using the crossing rates. The daily fixing system went smoothly until the US dollar strongly appreciated against all other currencies in 1981. Consequently, the baht continuously depreciated. In an attempt to stabilise the baht, the monetary authorities devalued the baht twice in mid 1981.

However, the devaluations failed to win public confidence. In July 1981, the daily fixing system was abandoned. The EFF resumed sole responsibility to determine the exchange rate but still provided an exchange swap arrangement for the commercial banks to hedge against exchange rate risk. From July 1981 to November 1984, the dollar exchange rate was fixed at 23 bath per US dollar.

November 1984 to July 1997: Pegged to the Basket of Currencies

During the mid 1980s, the Thai economy faced a serious economic crisis, following the second oil shock in the early 1980s. The world-wide recession and continuous economic difficulties at home led to the devaluation of the baht in November 1984 by almost 15% before the monetary authorities decided to reinstate the system of pegging the baht to the basket of currencies once briefly adopted in 1978. Under this system, the exchange rate of the baht against the US dollar was announced daily by the EEF, which stood ready to buy and sell US dollars with commercial banks at the announced rated. This system made the baht one of the most stable currencies in the world and supported Thailand's rapid growth between 1986-1995.

July 2, 1997: Managed Floated System

The coincidental sharp slowdown of export and capital inflows in 1996, together with mounting bad debt problems in the financial sector caused by a slump in the property sector resulted in a rapid deceleration of investment and economic growth. Thailand's excessive high current account deficit around 8 % of GDP in 1996 heavily funded by short-term capital inflows attracted speculative attacks on the baht. After facing unprecedented speculative attacks and a rapid depletion of international reserves, the Bank of Thailand was left with no choice but to allow the baht to float. Since 2 July 1997, Thailand's exchange rate system has been under a managed floated system. Under this system, the value of the baht is determined by market forces to reflect the country's economic fundamentals. However, the Bank of Thailand may occasionally intervene in the exchange markets to prevent excessive fluctuations of the baht.

Appendix III

Definitions and Sources of Data

Narrowly-defined money (M1)

M1 = currency held by the public plus demand deposits held by the non-bank private sector

Source: IMF International Financial Statistics (line 34)(1970M1-1996M6)

Commercial bank claims on the private sector (BC)

Commercial bank credit to the private sector

Source: IMF International Financial Statistics (line 22d)(1970M1-1996M6)

Inter-bank lending rate (money market rate)(INTER)

The inter-bank lending rate is the rate at which the commercial banks accept short-term deposits from other banks and financial institutions.

Sources: The Bank of Thailand's Quarterly Report(1970M1-1976M12)(1996M1-M6)
IMF International Financial Statistics (line 60b) (1977M1-1995M12)

Total reserves (TR)

Total reserves of the commercial banks.

Source: IMF International Financial Statistics (line 20) (1970M1-1996M6)

Demand Deposits (DD)

Demand deposits at the commercial banks: demand deposits earn no interest.

Source: IMF International Financial Statistics (line 24) (1970M1-1996M6)

Laspeyres's industrial output price index (P)

Details on how this price index is computed are provided in Chapter Six.

Sources: The Bank of Thailand's Quarterly Report(1970M1-1996M6)

Paasche's industrial output index(Y)

Details on how this output index is computed are in Chapter Six.

Sources: The Bank of Thailand's Quarterly Report(1970M1-1996M6)

Laspeyres's and Paasche's index numbers are probably the two most important index numbers in the statistical and economic theory of index numbers. Laspeyres's price index (P_t^{La}) and Paasche's output index (Q_t^{Pa}) can be used to compute an index measuring aggregate output (Y_t): $P_t^{La}\ Q_t^{Pa} = Y_t$ (Karmel, 1965).